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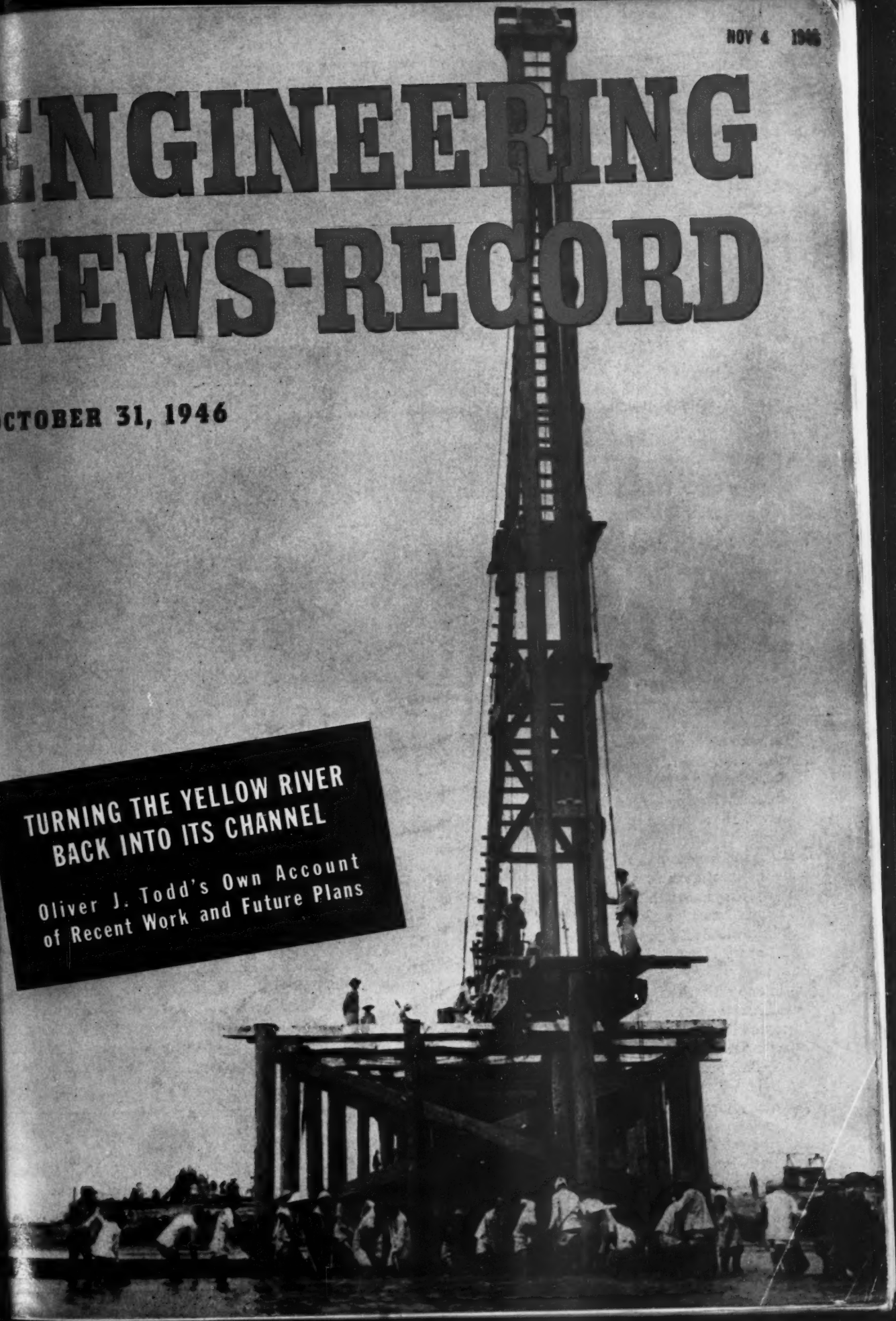
ENGINEERING NEWS-RECORD

OCTOBER 31, 1946

TURNING THE YELLOW RIVER BACK INTO ITS CHANNEL

Oliver J. Todd's Own Account of Recent Work and Future Plans



NEW SKATING RINK — ATLANTIC CITY MUNICIPAL AUDITORIUM

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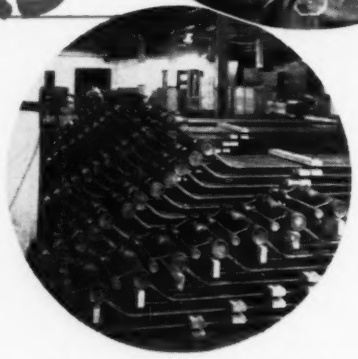

This ice rink is in the Atlantic City Municipal Auditorium, one of the most continuously busy buildings in the country. From January to December, the structure is in almost continuous day and night use for expositions, horse shows, conventions, hockey games, and ice shows. There isn't any convenient "time out" period for rink repairs, so the management naturally looked for the most durable and dependable piping material. The service of wrought iron pipe in the previous rink provided a right-at-home guide, and Byers Wrought Iron pipe was used.

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ENGINEERING NEWS-RECORD

Volume 137 • Number 18 October 31, 1946

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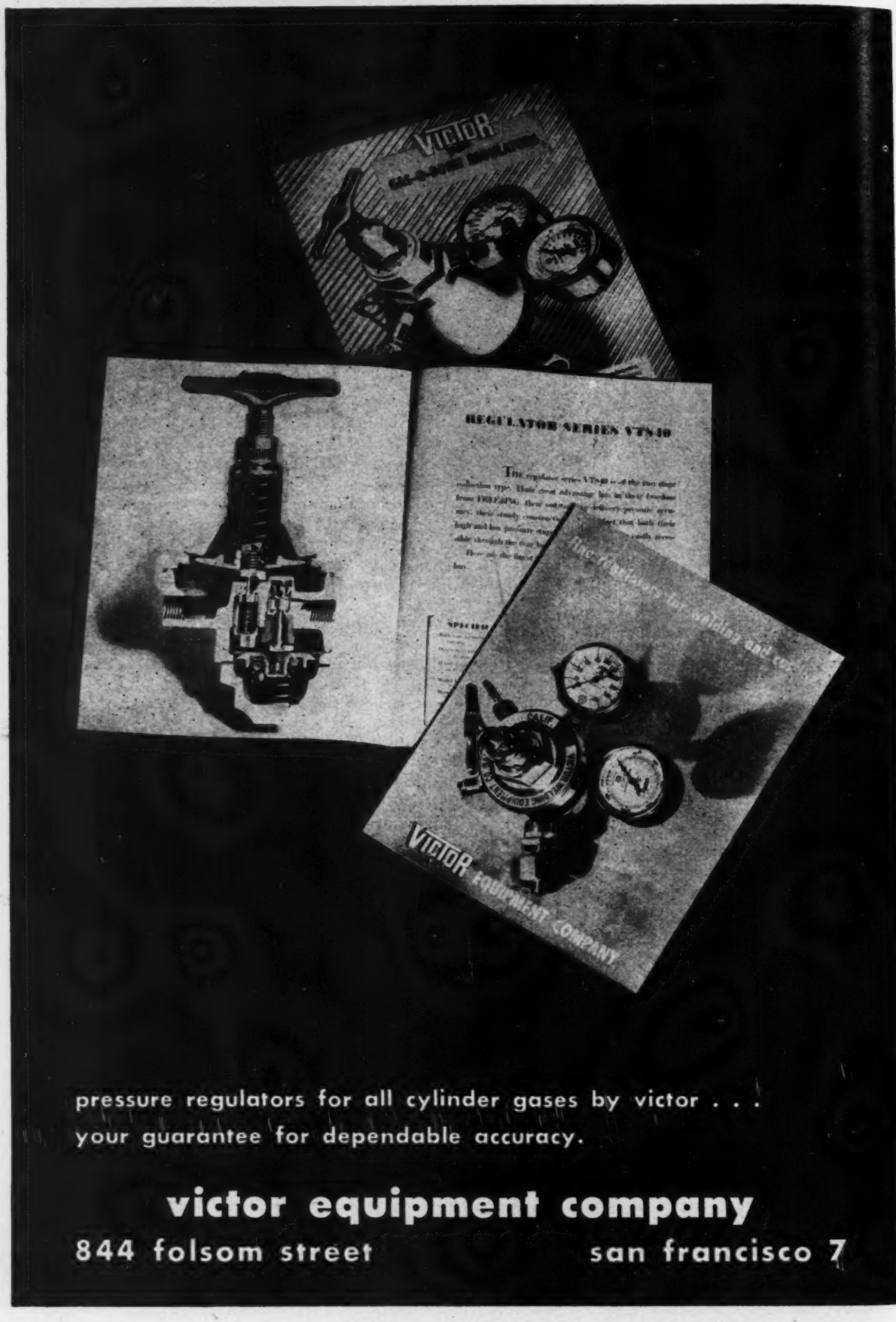

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Construction Trends

Construction Restrictions On, but Housing Volume Off

Volume of heavy engineering contracts awarded has taken a sharp downward turn since July. Weekly construction volume in August was $108,265,000, 19 percent below the July weekly average of $134,148,000. September recorded an additional drop of 14 percent, averaging only $93,264,000. Construction contracts awarded during the week ending October 24, 1946 totalled only $55,203,000, which is the smallest weekly contract volume recorded by *Engineering News-Record* since February of this year. The highest monthly rate so far this year was in April, when the *ENR* four-weeks moving average reached $134,877,000.

Underlying causes for this declining rate of awarding new contracts are many, including material shortages and high prices that result in bid rejections, but the government policies designed to expedite housing probably have had the most direct effect. The first of these, the March 26 order restricting non-essential industrial and commercial building, apparently made its mark in May, when the *ENR* four-weeks moving average for total engineering construction dropped 9 percent to $122,097,000.

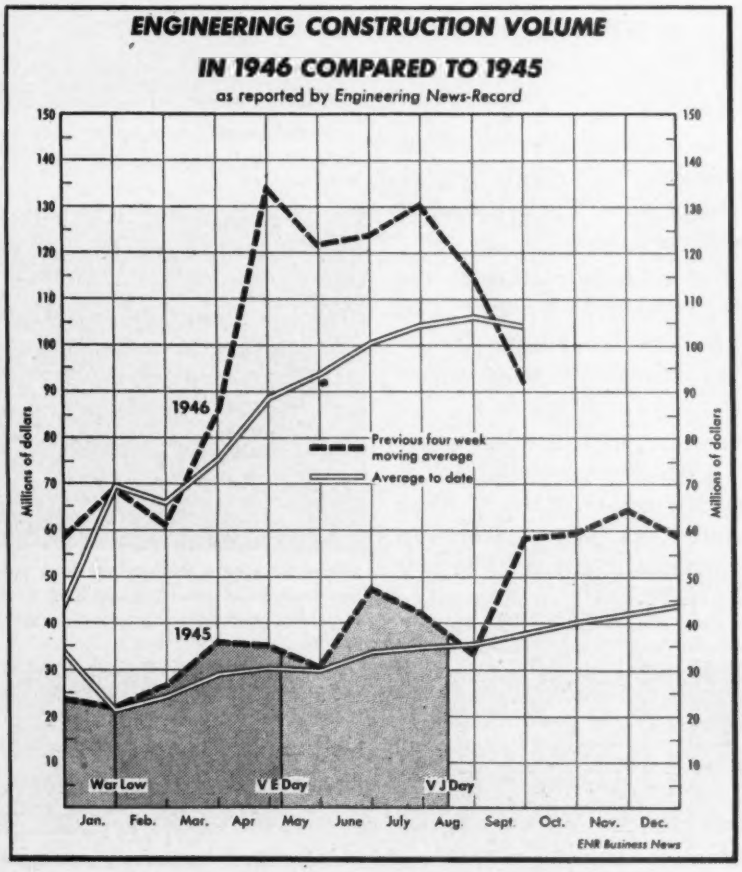
Mass housing established a peak in April with a weekly average of new contracts totalling $49,974,000. In May however, the average week dropped to $43,494,000; in June, to $42,554,000; and in July, to $33,266,000.

By July, however, total heavy engineering construction had climbed to $131,086,000, close to the April peak. The government's second program designed to channel materials and labor into housing was the federal construction moratorium, effective August 6, 1946. The effect of this new order can be gauged by weekly federal contract awards, which averaged $15,652,000 prior to the moratorium, but dropped 69 percent to a weekly average of $4,883,000 during the period from August 6 to October 24, 1946.

Total engineering construction volume averaged $106,379,000 per week prior to August 6, but then dropped 10 percent to a weekly average of $96,192,000.

Mass housing contracts in September averaged only $19,306,000 per week in spite of the priorities granted the housing program. This was 52 percent below the August weekly average of $39,887,000, and 39 percent below the 1946 weekly average of $31,828,000.

Mr. Wyatt's National Housing Agency figures on new conventional dwelling units put under construction confirm this decline in housing construction; the peak occurred in May, 64,500, then 60,300 in June, 60,600 in July, and 59,900 in August. These totals compare with a monthly average through August of 55,437 units.



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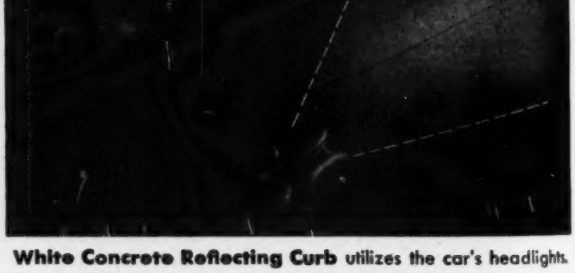

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News of the Week

ENGINEERING NEWS-RECORD • OCTOBER 31, 1946 • VOLUME 137 • NUMBER 18

Army civil works cut most under economy rulings

Analysis of results of President's call for savings in federal expenditures shows Reclamation, Veterans Administration, flood control work only lightly hit

A detailed analysis of results of President Truman's Aug. 5 call for economies in federal construction work, in the light of expenditures finally approved last week (*ENR* Oct. 24, vol. p. 543), indicated that the civil works program of the Army Engineers was hardest hit in the economy move. General programs of the Bureau of Reclamation, the Tennessee Valley Authority and the Veterans Administration apparently will continue almost as originally scheduled.

Because orders pertaining to construction were issued almost simultaneously by the President, the Bureau of the Budget and the Office of War Mobilization and Reconversion, much confusion has arisen as to what all these orders mean. The President's Aug. 5 order limited actual expenditures by the federal agencies for public works construction to $900,000,000 during the present fiscal year, which began July 1, listing specific amounts that some agencies might spend during the present fiscal year. The ceilings for four organizations have now been revised upward by the President and the budget bureau with the total increase only about $83,000,000 so far, although other increases may follow.

In the meantime, OWMR has ruled that the 14 agencies involved can have a program this year with a total put-in-place value of $1.2 billions. This figure represents the value of the completed projects, many of which will not be finished this year, rather than expenditures before June 30, 1947.

With the $83,000,000 upward revision in Mr. Truman's limiting order, the Reclamation ceiling has been increased by $25,000,000, or up to $110,000,000, the $95,000,000 limit on the Army Engineers' flood control program by $40,000,000; the TVA ceiling by $13,000,000 and that on Agriculture Department construction by $5,000,000.

Civil works hard hit

The ceiling on the flood control construction by the Army Engineers has been increased from $95,000,000 to $135,000,000, but the $90,000,000 top on rivers and harbors construction—of which only $25,000,000 can be spent for new projects—remains unchanged. As a result the civil works program is hard hit: the corps had a total of $521,000,000 available at the start of this fiscal year for civil works construction alone, and had already awarded a volume of contracts exceeding the first ceilings set by the President when he issued his Aug. 5 order. Moreover, maintenance and operation work is limited under the order and most expenditures for detailed planning must come under the new ceiling.

So severe was the first limit that the army had already reduced its staff in some civil works offices and this trimming of personnel will need to be continued. Some investigations must also be closed down completely.

Military construction operations are also to be limited. Less than $100,000,000 of work may be carried out by the War Department outside of the country this year and even less within the U. S.

New reclamation contracts

Reclamation is fortunate in that the ceiling does not apply to investigations and operations and maintenance. The net result is that the increase up to $110,000,000 will permit several new contracts with an appreciable volume to be awarded. These awards will be confined primarily to going projects.

Work to go ahead in the bureau's regional divisions includes—Region I: the Boise-Anderson Ranch project, Boise-Payette development, Columbia Basin project, Deschutes project, Hungry Horse Dam, Minidoka project, Owyhee project and the Yakima-Roza work. Region II: the Central Valley Development and the Klamath job. Region III: the Coachella branch of the All-American Canal, Davis Dam, the Gila project, and power work at Parker Dam. Region IV: The Ogden River project, the Provo River work and the Scofield job, all in Utah. Region V: Additional contracts for the Balmohea, Lugert-Altus, Rio Grande, and Tucumcari projects. Region VI: The Fallon unit of Buffalo Rapids, Rapid Valley,

(*Continued on page* 40)

Local units plan $6 billion works

Public works now projected by state and local governments would cost $6,000,000,000, Maj. Gen. Philip B. Fleming, Public Works Administrator, has announced, but at the same time he added that it is uncertain how many of the projects already brought to the design stage can be completed without federal aid.

While a good start has been made toward an original goal of $5,000,000,000 of public works as a means of maintaining employment in the construction industry, General Fleming declared that present inflated costs would make that figure short of the desired amount.

"A dollar volume of public works construction that promised, a year ago, to furnish a given amount of construction employment," General Fleming said, "would now fall short of the results then expected.

"It is indeed difficult at this time to fix a planning goal in terms of dollars, in view of the rising trend in the cost of materials and labor."

The reserve of public works planned, the Public Works Administrator, added, will help stabilize the construction industry after the present demand for private housing tapers off.

NEWS IN BRIEF

In telegraphic form, here are latest news developments on the engineering and construction front during the week.

Construction — Construction has started on a $1,000,000 plant for Schenley Distilleries, Inc., at *Phoenix, Ariz.* . . . The Illinois Bell Telephone Co. will erect an $11,500,000 central office building at 2940 Courtland St., *Chicago, Ill.* . . . Bids are to be invited for a $400,000 hospital at *Vernon, B. C.* . . . Plans for an $18,000,000 newsprint mill at *Childersburg, Ala.*, were announced at a recent meeting of the Southern Newspaper Publishers Assn. . . . The Texas Co. has announced plans for the modernization of its refinery at *West Tulsa, Okla.*, to cost over $2,000,000. . . . The Standard Paving Co. has started pouring concrete on a $750,000 runway and taxiway at Port Field, *Ft. Sill, Okla.* . . . F. H. McGraw & Co., constructors, Hartford, Conn., have been awarded a contract totaling "several million dollars" by the Bakelite Corp., a unit of the Union Carbide and Carbon Corp., New York, for the construction of a manufacturing plant at *Ottawa, Ill.*

Highways—The Indiana State Highway Commission has plans for construction and widening of Meridian Street, *Indianapolis* next year. . . . The *Texas* State Highway Commission will call for bids soon on construction of 287 miles of farm-to-market roads and urban expressways estimated to cost $2,000,000. . . . A new international bridge has been proposed to cross the St. Croix River between *Calais, Me.*, and *St. Stephen, N. B.* . . . A total of 366 *Oklahoma* road projects, at an estimated cost of $22,910,317, are contracted and under construction, the State Highway Commission has reported.

Sewers and Water Supply—First step of an $83,400 sewer expansion program for *La Mesa, Calif.*, was the recent appropriation by the city council of $2,000 for a preliminary survey. . . . *Rockford, Ill.*, has approved a $260,000 waterworks improvement and expansion program. . . . *Defiance Ohio*, will spend $125,000 for improvements at the municipal water works filtration plant. . . . Plans are under way for a $600,000 sanitary sewer system and disposal plant at *Paris, Tenn.* . . . *Boise, Ida.*, has retained Alvord, Burdick & Howson, Chicago consulting engineers, to prepare plans for construction of a $600,000 sewage treatment plant and extension of mains.

Housing — Charles B. Taylor and others have acquired 25 acres of land in Homewood, *Birmingham, Ala.*, and will construct 250 unit apartments as soon as plans have been approved by FHA and material can be obtained. The project will cost about $2,000,000. . . . M. Giller Investment Co. of Miami, Fla., has announced a program, involving the construction of 103 houses in *Dade County*, at a cost of $1,000,000. . . . Since the first of the year, construction has been started on 3,405 private family dwelling units in the *Atlanta, Ga.*, area. . . . Worsham Brothers Construction Co. of Knoxville, Tenn., has 125 new residences under construction at *Alcoa, Tenn.*, in a $600,000 program. . . . Practical Home Builders has 250 brick houses under construction at *Miami Beach, Fla.* for $1,000,000.

NHA extends building machine freeze

The War Assets Administration last week advised its 33 regional offices that the National Housing Expediter has extended the "freeze" on nine kinds of new and used construction machinery for 30 days, in furtherance of the Veterans' Emergency Housing Program.

During the freeze period, WAA may sell this equipment only to purchasers holding a Housing Expediter directive or certificate, or a Civilian Production Administration special directive or urgency certificate.

The items were first frozen by NHA on Sept. 3, by issuance of Housing Expediter Priorities Regulation 3. The additional 30-day freeze period, mandated by issuance of an amendment to HEPR 3 effective October 16, will expire on November 17.

Seven of the frozen items had been set aside by WAA for exclusive sale to veterans. They are: batching plants; cranes (truck mounted and tractor crawler type); ditching machines; portable air compressors (100-500 cfm inclusive); rock crushers (25 tons per hour or under); track-laying tractors; and tractor-type scrapers.

Persons who will use one of these seven items for the Veterans Emergency Housing Program, and who also hold a WAA veteran's certificate, will be given first preference in purchasing the equipment.

The two other frozen items are motor graders and wheel tractors 100 H.P. or over.

All nine of the frozen items are in short supply, and it is considered probable that the available supply in government surplus will be taken up completely during the freeze period by persons engaged in construction of housing for veterans, and persons certified by the Housing Expediter or the Civilian Production Administration to buy the equipment for reasons of urgent need.

Plan $10 million Florida bridge

Construction of an 11-mile, $10,000,000 steel bridge across the mouth of Tampa Bay will start early in 1947, the St. Petersburg, Fla., Port Authority said last week.

Authority engineers said that cost estimates and preliminary plans for the project have been made, and War Department approval—necessary because the bridge will cross navigable waters—has been received. E. Leslie Cole, chairman of the port authority, said plans and specifications will be ready by January 1, and bids will be called shortly thereafter.

Northern terminus of the bridge-causeway will be Maximo Point, the southeast tip of the Pinellas County peninsula. From this point, the structure will extend southward for about a third of a mile to the vicinity of Mullet Key, and then turn slightly southeast to reach the shore of Manatee County.

The crossing will include nine sections of solid fill, totalling about 49,600 lin. ft., connected by eight open trestle bridges, totalling about 17,400 ft. in span. The largest open span, crossing the main ship channel, will be 800 ft. long, and will clear the channel mean high water by about 145 ft.

The bridge will support a 32-ft. roadway, including shoulders, with a 26-ft. paved width. Ball, Horton & Associates, of Ft. Myers, Fla., are architect-engineers, and Parsons, Brinckerhoff, Hogan & Macdonald of New York are consultants.

The new structure will be the third over-water route from Pinellas Peninsula to the Florida mainland. Davis causeway, built in 1934, connects Clearwater and Tampa, and Gandy Bridge, built in 1924, connects the Tampa-Port Tampa area. The only crossing of the lower bay, at present, is a ferry line operated by the St. Petersburg group.

ASCE urges raise in engineers' pay, revises professional classifications

Board of Direction approves interim salary report—Council for Professional Development cites low pay to college graduates

Private employers and all subdivisions of government should soon bring the salaries of engineering employees up to or above the standard scale for engineers in federal service, the Board of Direction of the American Society of Civil Engineers urged recently in accepting an interim report of its Committee on Salaries.

With this recommendation, the board also approved revisions in its nine-grade classification list, to bring the classifications into line with rankings in federal service, and set up recommended annual minimum salaries ranging from $2,700 for Grade I to $12,600 and up for Grade IX.

In a somewhat parallel action, the Committee on Engineering Schools of the Engineers' Council for Professional Development last week made public a study showing average salaries paid to recent engineering school graduates, and expressed concern over the "apparent unwillingness" of industry to pay considerably higher rates to men with graduate study behind them than to men without that training.

Both reports are given in detail in the accompanying tables.

The ASCE action at its fall meeting in Kansas City (*ENR* Oct. 24, vol. p. 548) supersedes similar recommendations for salaries and classification of the various grades for engineers approved by the Board of Direction in July, 1944, after it was found that the society's classifications differed sufficiently from federal classifications to make comparison difficult.

New classifications

The new classifications approved by ASCE are:

Grade I—Positions that involve, under immediate supervision, the performance of simple and elementary civil engineering requiring professional training, but little or no experience.

Grade II—Positions that involve, under immediate or general supervision, individually or with a small number of subordinates, the performance of civil engineering duties requiring professional training, previous experience, and to a limited extent the exercise of independent judgment.

Grade III—Positions that involve, under general supervision, the performance of civil engineering duties of substantial difficulty and responsibility, requiring professional training, previous experience, and independent judgment.

Grade IV—Positions that involve, under general supervision, the performance of difficult civil engineering duties, or the supervision of a subdivision of an engineering organization, requiring professional training, previous experience, recognized leadership and independent judgment.

Grade V—Positions that involve, under general supervision, the performance of difficult civil engineering duties or the supervision of a division of an engineering organization, or the direction of a staff on investigation studies, research, testing, design, or construction, requiring professional training, previous experience, recognized leadership and independent judgment.

Grade VI—Positions that involve, under general direction, the performance of difficult civil engineering duties or the supervision of a division of an engineering organization, or acting as principal assistant to the head of a division of a large engineering organization, or the direction of a staff on investigative studies, design or construction, requiring professional training, successful experience in engineering work.

Grade VII—Positions that involve, under general direction, the performance of important engineering duties or the supervision of a division of a large engineering organization, or the direction of a staff on investigative duties, design or construction requiring professional training, extensive successful experience in engineering work with demonstrated aptitudes and capacity for increased responsibilities in managerial and executive functions of engineering work.

Grade VIII—Positions such as: (A) The assistant to the technical and administrative head of an engineering organization; (B) The technical and administrative head of a lesser engineering organization; (C) Positions involving the development analysis, and evaluation for final executive action of difficult and complex engineering projects with respect to their feasibility, cost, economic justification and public necessity or convenience.

Grade IX—Positions such as: (A) The administrative and professional head of an important engineering organization with full authority and responsibility for conceiving and executing all the plans and functions of the organization, directing an administrative staff and professional engineering staff engaged in varied important projects; (B) Positions requiring highly specialized professional engineering or scientific knowledge.

Pay to recent graduates low

Results of the study of salaries paid to recent engineering school graduates, made in May of this year by the ECPD committee, were based on 75 replies to 200 questionnaires sent to manufacturers, and utility and railroad companies.

In many instances, the information given for a particular classification was the starting salary for new employees in that classification.

In partial explanation of this condition, H. S. Rogers, president of the Polytechnic Institute of Brooklyn, observed that the chemical engineering industries are about the only ones in which recent graduates can be placed in higher salaried positions without some practical experience in the industry.

TABLE I: PROPOSED ENGINEERS' YEARLY SALARIES

Salary rates proposed by the ASCE in 1944		Current federal employee wage rates		Current recommendations of the ASCE	
Grade	Rate	Grade	Rate	Grade	Rate
I	$1,980–2,460	....	.....	....	.....
II	2,460–3,000	P-1	$2,645– 3,400	I	$2,700– 3,400
III	3,000–3,600	P-2	3,400– 4,150	II	3,400– 4,200
IV	3,600–4,200	P-3	4,150– 4,900	III	4,200– 5,100
V	4,200–5,160	P-4	4,900– 5,900	IV	5,100– 6,100
VI	5,280–6,480	P-5	5,900– 7,100	V	6,100– 7,250
VII	6,720–7,920	P-6	7,100– 8,180	VI	7,250– 8,600
VIII	8,160–9,360	P-7	8,180– 9,970	VII	8,600–10,350
IX	9,600 and up	P-8	9,970–10,000	VIII	10,350–12,600
....	.....	P-9	10,000 and up	IX	12,600 and up

TABLE II: SALARIES PAID ENGINEERING GRADUATES BY MANUFACTURERS, RAILROADS AND UTILITIES

	Low	Salaries per Month	
		Average	High
For inexperienced graduates (68 returns)	$150	$206	$261
For inexperienced graduates with master's degrees (56 returns)	150	229	288
For graduates with three years of satisfactory experience:			
Bachelor's degree (53 returns)	200	275	350
Master's degree (44 returns)	225	303	450
For graduates with five years of satisfactory experience:			
Bachelor's degree (48 returns)	250	328	450
Master's degree (39 returns)	250	356	462
For graduates with doctor's degrees (28 returns)	225	326	500

Federal economy order

(*Continued from p. 37*)

Milk River, Missoula Valley, Fort Peck power, Riverton, Shoshone, Sun River, Angostura Dam, Boysen Dam, and Missouri Basin transmission lines. Region VII: Construction will be advanced on the Colorado-Big Thompson project, Kendrick, Mirage Flats, and Kortes Dam.

Hospital program not restricted

The huge veterans hospital program being carried out by the Corps of Engineers for the Veterans Administration is not restricted by the order. Therefore, they will go ahead with the award of many large hospital construction contracts in the next six months. Congress gave VA contractural authority to the total amount of $772,000,000 for the planning, design, and construction of hospitals, and the VA called in the army engineers to assist in the big job (*ENR* Feb. 21, vol. p. 265).

Architect-engineer contracts have already been awarded for 48 VA hospitals and about seven others are under negotiation.

TVA gets boost

The Tennessee Valley Authority has fared much better. It has been given the authority to go ahead with $13,000,000 of additional construction this fiscal year. This increase brings to $29,000,000 the amount TVA will be allowed to spend on construction work. Two major projects are involved—Watauga Dam, on which actual construction is being carried forward at a good rate, and South Holston Dam, for which the preliminary work will be done.

The $5,000,000 increase for the Department of Agriculture will be used to award additional contracts for forest highways and some minor flood control work by the Soil Conservation Service.

The Public Roads Administration reports that its position regarding construction remains unchanged—it will continue to approve only highway work which is urgently needed.

The airport program of the Civil Aeronautics Administration is also expected to be small this year. The CAA program does not come under the President's order, but this agency received only $45,000,000 for construction in the fiscal year 1947. Of this amount, $30,822,750 has been apportioned to the various states, $10,274, 250 is to be spent as a discretionary fund under supervision of the CAA administrator, $2,163,000 will be used for administration expenses, and $1,740,000 is earmarked for projects in Alaska, Hawaii, and Puerto Rico.

E. J. CLEARY . . . .

Letter From Latin America

. . . . Which contains some philosophizing on the good will created by good engineers at work "south of the line"

Barranquilla, Colombia — Engineers from the United States have long enjoyed the distinction of being among the best "imports" reaching Latin America. They bring the technical skill and know-how by means of which the countries south of the border have been aided in realizing their aspirations for development of resources.

As working proponents of the "Good Neighbor" policy, probably no group has made a greater contribution of genuine value than those engineers who have lived and worked in these countries.

Not the least of these is Samuel L. Hollopeter, director-general of the Empresas Publicas Municipales of Barranquilla, Colombia. Reared in Indiana and educated at both Columbia and DePauw universities, he came to Barranquilla in 1925, after varied experiences with the Army Engineers and with the Ohio State Department of Public Health.

Two decades of service

It was my privilege to reach Barranquilla on the day that Sam Hollopeter received a cable from the States saying his resignation had been "accepted with deepest regret". For 21 years, he has directed the unique municipal corporation that manages, constructs and operates public works in this South American city under a private financing arrangement with Chicago's City National Bank and Trust Co. (formerly the Central Trust Co. of Illinois). I say it was privilege to be here at this time because it furnished an opportunity to witness the response of the people in a South American city to the departure of a North American engineer who had labored with them to create what is today considered one of the best-operated cities anywhere in the tropics. See *ENR* May 4, 1944, vol. p. 654).

As I sat in Hollopeter's office only a couple of hours after the news of his resignation appeared in the newspapers, the phone rang constantly, bringing messages of disbelief and regret. As the day wore on, citizens representing virtually every walk of life called at the office to confirm with sadness what they had read. Both the Lions and Rotary clubs called meetings to pass resolutions lauding his service and asking him to reconsider his decison to leave, and the newspapers carried editorials extolling the work he had done.

It was as much a tribute to the man as it was recognition of his accomplishments in the transformation of Barranquilla from a dirty, sprawling river town into a most modern and healthy city.

An unusual opportunity

Hollopeter's resignation — based partly on health reasons and on his own theory that when a man reaches 60 it is time for someone younger to take over—will provide the opportunity for another engineer from the States to promote inter-American relations and at the same time develop his career in a public service enterprise of challenging proportions.

Sam Hollopeter

Barranquilla, the same as any city in the States, has its elected municipal council with accompanying political shenanigans. Along with this there is labor unrest with demands for wage increases to meet higher costs of living. To cope with these matters, maintain engineering and construction activities, and at the same time act as a trustee of the loans and collections for a private banking firm in Chicago calls for a man of unusual qualifications.

For a few brief hours your correspondent was the subject of critical scrutiny by a good many of the 700 employees under Hollopeter's direction. Being escorted about by him to various jobs and then huddled over his desk with a notebook so soon after the resignation had been announced, the word quickly spread that I was the new "jefe."

Growing consternation throughout the organization over the thought that after 21 years Sam Hollopeter had finally made a mistake was not dispelled until the next day when I climbed into a car for the airport.

AGC demands lifting of all controls governing construction industry

Contractors declare industry can operate more efficiently if restrictions on suppliers and builders are removed

Fed up with restrictions and controls that, they claim, hamper all construction and especially housing, the Associated General Contractors at their fall meeting in Philadelphia last week demanded the lifting of all regulations applying to construction.

This stand, reiterating one taken last July at the Denver meeting, was outlined in a resolution stating in part: "The construction industry can execute the projects of all types vitally needed for the development of the nation more quickly, more efficiently and more economically if governmental restrictions and control over the construction industry and those supplying it are abolished. We recommend the immediate removal of these controls so that the industry can serve the public to the fullest extent of its capacity."

The delegates particularly deplored the increasing curtailment of non-housing building construction. Charts and figures were presented to show that successive curtailment of industrial and commercial construction has not helped the housing program one bit. No expected surges in housing have been forthcoming following any of the curtailment orders, according to the data presented.

OPA's plan for extending MPR 251, governing contractors' mark-up of prices, to regional control has been postponed, the meeting was informed, "because of necessity of setting prices on 'hard' construction materials."

Some time ago the AGC requested OPA to remove the price ceilings on reinforcing bars as a means of stimulating production and thus remove the current shortage in this commodity, but OPA officials reported to the convention that such removal was impossible as long as shortages exist. A study of construction materials reveals that tile, cast-iron radiators, softwood plywood, bathtubs, nails and gypsum block are extremely short at the moment, with little hope for immediate relief, and the situation is complicated by a shortage of freight cars. The AGC has been influential, it was reported, in lowering the quota of reinforcing bar exports to South America and to the postponement of a State Department proposal to ship 7,500 tons to Europe.

The Market Development Committee report stressed the need for preserving present construction markets rather than to seek new ones at this time. The report expressed the opinion that extension of markets now would only serve to further raise construction costs.

A resolution called upon state, county and municipal public works officials "having jurisdiction over the construction and maintenance of roads, streets, sewers, utilities and other facilities necessary for the protection of the health and safety of the citizens to vigorously protest any attempted curtailment of such needed construction and to proceed with the same whenever possible concurrently with the construction of facilities required in connection with the Veterans Housing Program."

Labor problems

Following the trend of the past several years, about half of the convention discussions pertained to labor relations. It was pointed out that construction, under the Wage Adjustment Board, is the only industry not allowed to set its own wages even where no increase in cost of product might result from increasing wages. Fear was expressed that if the WAB controls are kept in force that public works agencies, not affected by WAB rulings, might do their own construction by day labor, paying higher wages than contractors are allowed to pay in order to get the necessary workmen. The University of Colorado, building its own dormitories is cited as an example.

Much speculation ensued as to what might happen when and if WAB is abolished. The consensus indicated that some new wage demands would be probable and some existing labor contracts might be abrogated, but in general present agreements and contracts would be respected. There would probably be some pressure brought to increase wages on cost-plus-fixed-fee work. But, everyone agreed, true collective bargaining would become a reality. Contractors will, however, find many changes in labor philosophy since they last were able to bargain collectively, warned J. D. Marshall, AGC labor expert. Social benefits, vacation pay, pensions, etc., are here to stay, he pointed out.

Managing director H. E. Foreman in an annual report placed the source of most of the contractors' problems in governmental controls, and stated the future stability of the contracting industry is threatened by continuance of such controls and by efforts to establish agencies patterned after TVA.

Parrott and Winkelman named

Forrest Parrott, C. F. Lytle Co., Sioux City, Ia., present vice president, was nominated for president for 1947. Dwight Winkelman, Syracuse, N. Y., was nominated for vice president. The annual meeting will be held at the Stevens Hotel in Chicago Jan. 27-30.

Discuss highway equipment progress

Equipment trends, needs and possibilities were discussed at a joint meeting sponsored by the Highway Research Board and the American Road Builders Association at Washington Oct. 23-24 attended by nearly 200 highway engineers, manufacturers and contractors.

While nothing conclusive came out of the meeting, those in attendance got a better understanding of what equipment is now available, what is planned for the immediate future, and what is wrong with equipment now in use.

The meeting was divided into three consecutive sessions, dealing with concrete paving, bituminous construction, and grading and earthmoving. The session on concrete paving, under the direction of Charles W. Allen of the Ohio State Highway Department, paid most attention to vibrating equipment.

George Dent of the Asphalt Institute, led the second session devoted to bituminous equipment. Here the merits of both continuous and batch mixers, both in common use on bituminous work, were discussed. Manufacturers pointed out that most of the complaints directed against present bituminous equipment were due to use of obsolete machines.

Grading, hauling and earthmoving equipment seemed satisfactory to most of the delegates, and few suggestions were made for improvements or new models.

Equipment for the compaction of fills created the most interest in this session, manufacturers revealing plans for producing vibrating rollers that will compact the soil deep below subgrade. One such rig will weigh 30 tons, mounted on two huge pneumatic tires whose air pressure will be varied to suit the carrying capacity of the soil to be worked. The discussion was led by Prof. Kenneth B. Woods of Purdue.

ASCE technical divisions consider city decentralization and river work

Four methods for checking decay of metropolitan centers proposed to city planners—Waterways and sanitary divisions meet

Eight technical divisions of the American Society of Civil Engineers held meetings at Kansas City, Mo., Oct. 16-17, following the general meeting reported in last week's issue (*ENR* Oct. 24, vol. p. 548). Interest centered in the Missouri River valley, where the meeting was held, and especially in the river development work under the Pick-Sloan plan, now being put into effect.

An evaluation of the sanitary aspects of the proposed program for developing the Missouri River valley will require an analysis of the water resources from the standpoint of water available both now and after the development has taken place, according to Earnest Boyce, professor of municipal and sanitary engineering, University of Michigan, who opened the Sanitary Division meeting with a review of sanitation developments in the valley.

A preliminary report on wintertime minimum flow dilution, prepared in 1943 by the U. S. Public Health Service, shows average coliform concentrations of Missouri River water at Omaha, Atchison and the Kansas City far in excess of safe maximum limits. Moreover, it is estimated that the combined effect of domestic sewage and industrial wastes discharged into the lower section of the Missouri, exclusive of its tributaries, equals the pollutional load produced by the domestic sewage waste of a population of 3,210,000. Despite this pollution load, the river now serves as a source of public water supply for 15 municipalities with a combined population of 1,351,800, below the Fort Randall damsite.

Following Professor Boyce's over-all report, representatives of Missouri valley states reported on how current sanitary conditions would be affected by the Pick-Sloan plan.

Kansas—Paul D. Haney, chief engineer, Division of Sanitation, State Board of Health, Lawrence, Kan.: The chief problem in the middle and eastern parts of the state, expected to be substantially alleviated by the Missouri River Valley development program, is the stabilization of low stream flows to assure satisfactory water supplies to municipalities, industries and for assistance in waste disposal.

Missouri—W. Scott Johnson, director, Section of Environmental Sanitation, Missouri Division of Health, Jefferson City, Mo.: The sanitary engineering aspects of the development program within Missouri constitute no unusual or unreasonable problems. However, certain flood control dams proposed under the plan will cause flooding of some existing sanitary structures such as water supply intakes, sewage treatment plants and outfall sewer lines. Also, several sanitary problems will result from the establishment of permanent pools produced in conjunction with new flood control reservoirs.

South Dakota—W. W. Towne, director, Division of Sanitary Engineering, State Board of Health, Pierre, S. D.: Although only three municipalities in South Dakota use the Missouri River for water supply and seven use it for sewage disposal, the Missouri Valley development program will contribute much to the creation of a more sanitary environment throughout the state.

Creation of two large reservoirs on the river by construction of the Oahe and Fort Randall dams will flood two existing small water treatment plants, requiring their reconstruction.

At the same time, however, the load on sedimentation basins and water treating equipment will be reduced materially, and the natural clarification of the reservoir waters should result in an over-all improvement at the treatment plants.

North Dakota—Jerome H. Svore, director, Division of Sanitary Engineering, State Department of Health, Bismarck, N. D.: Probably the greatest single benefit to sanitation in North Dakota from the Missouri River valley development program will occur in the Red River basin. This benefit will be derived from the diversion of Missouri River water from the Garrison or Fort Peck dams into Devils Lake and into the Sheyenne River which flows into the Red River.

Practically every municipality and industry in the Red River basin must provide additional and more complete treatment of their water. Even with this additional treatment, river conditions will not be entirely satisfactory, especially during heavy ice conditions in the river, unless the development plan is carried to the point where adequate storage can be provided in the Sheyenne River basin for release during periods of low flow.

Plan curbs on cities' decentralization

Four steps that must be taken to check rapid deterioration of the older central areas of most cities were laid for consideration before a panel of the City Planning Division at the ASCE meeting.

These steps are: (1) Make the downtown areas more accessible by providing ample off-street parking and by increasing the efficiency of mass transit facilities; (2) Construct more urban arterial routes into metropolitan centers, with efficient downtown interchanges to speed the flow of traffic; (3) Secure federal assistance for low-income housing, and (4) Find additional means of taxing those who live outside city limits, yet who earn their livelihood in town.

In a statement of the problem of recentralization, John M. Picton, chief planning engineer, Kansas City, Mo., declared that many cities are suffering from decay, internal pains, poor circulation, congestion and cancerous growths of slum areas.

Over one-third of the population is poorly housed, in obsolete structures needing major repairs and lacking sanitary facilities. Moreover, additional blighted areas are being created rapidly in newer sections and beyond the city limits due to poor initial subdivision layout, septic tank installations, etc. In many instances the congestion which these people sought to avoid often comes quickly to those outlying areas where they hoped to have more light, air and open space permanently.

More transit facilities needed

As an example of the urgent need for better transit facilities as one means of decreasing the operation of private cars in downtown areas, Russel H. Riley, consulting engineer, St. Louis, cited a recent study of mass transportation in a midwestern city.

In this city it was found that 54 percent of those persons entering the business district during an average day used the transit facilities. The 146,900 that entered by auto utilized 85,263 cars, while the 173,000 who entered via the transit system required only 5,129 vehicles. Thus it would seem obvious that if transit vehicles are modernized and the service improved, more and more persons will travel on the mass-transportation lines. Considerable hope that the current

rapid decentralization of metropolitan areas can be checked was gained from experiences of the state of New York, as presented by Leonard A. Bergman, director, Bureau of Planning, New York State Department of Commerce, Albany, N. Y. The state legislature, by its action enabling construction of major routes through cities, at state expense, has relieved the local taxpayer of a fiscal nightmare, said Mr. Bergman.

In a somewhat contrasting view to that of other members of the panel, Earle S. Draper, planning consultant, FHA, Washington, D. C., believes the city and its business interests must accept the growth of outlying areas as an inevitable modern trend of natural development.

Master planning and tighter zoning control is a prime necessity, Mr. Draper said, but that merely provides the pattern of operation and does not guarantee action. Replanning and new development of blighted and slum areas should be carried out to produce a lesser density of population, lower percentage of land coverage, and a more open development — whether the redevelopment be residential, industrial or land in public use.

Such a program, in most instances, will produce less tax return. This clearly points to the necessity for consideration of occupational taxes, sales tax and other taxes that will bring a return from people living outside the city but benefiting from employment therein.

Review midwest river control problem

Headed by Col. Malcolm Elliott, Corps of Engineers, U. S. Army (retired), a 6-man panel of officers and civilian employees of the U. S. Army Engineers discussed several aspects of the continuing fight to stabilize and control both the Missouri and the Mississippi river before the Waterways Division at the recent ASCE Kansas City, Mo., meeting.

Selection of the basic method for improving a river for navigation depends entirely on the character of the stream, its flow characteristics, channel cross-section, alignment and slope, amount of suspended matter and the nature of the streambed and banks, according to Colonel Elliott, who presented a paper on the advantages of providing open channels for navigation as compared with the building of locks and dams for that purpose.

Chief among the factors influencing the adoption of open-channel methods of navigation improvement is a discharge sufficient to create an adequate body of water having tolerable velocities. Moreover, the cross-section of the stream should be sufficiently larger than that of vessels using it so that the propelling of vessels does not require excessive power. A large suspended load in a stream is disadvantageous to control by locks and dams and thus may be considered a factor favorable to the use of open-channel methods of improvement. Curvature elimination, on the other hand, is more difficult with open-channel rivers than with pools formed by locks and dams.

Dredging the Mississippi

Channel maintenance by dredging along the middle and lower Mississippi River during recent years has cost from 5 to 6 cents per cubic yard, according to Lawrence B. Feagin, head engineer, U. S. Engineer Department, St. Louis, Mo. Of the two types of dredges used chiefly in this work, the cutterhead and the "dustpan" dredge, the latter has proved more economical of operation, under especially favorable conditions.

Cutterhead dredges having a 22-in. intake and a 20-in. discharge, cut a 250-ft. width while advancing about 35 ft. per hour against a 3 to 4-ft. face, continued Feagin. The dustpan dredge, with 24-in. and 32-in. discharge pipe cuts a 28-ft. and 32-ft. width, respectively, while advancing 300 ft. per hour against a 3 to 4-ft. face.

Shrinking the Missouri's channel

Contraction of the channel is one of the principal features in the development of the Missouri River now being improved from its mouth near St. Louis to Sioux City, Iowa, said Lt. Col. Delbert B. Freeman, district engineer, U. S. Army Engineers, Omaha, Neb. The prime objective is to collect the meandering waters of the numerous channels and confine all the flow to one fixed channel, thus contracting the stream sufficiently so that minimum navigable depth can be obtained with a minimum of dredging.

Following extensive studies it was decided to design the improvement for a contracted width of 1,100 ft. at the mouth of the river, decreasing it to 700 ft. at Sioux City. In this alluvial stream, which carries a heavy load of sediment during high water, contraction can best be accomplished by installing permeable dikes, fixed in place by revetted banks.

Soil banks and river beds

The soil characteristics of a river's bed and banks not only influence the selection and design of open-channel method of improvement, but in a large degree determine whether such improvement is required, declared Charles Senour, head engineer, Mississippi River Commission, Vicksburg, Miss.

To illustrate, the minimum discharge of the lower Mississippi River during an extremely low water period in 1939 was 75,000 to 88,000 cfs. between Cairo, Ill. and the mouth of the Arkansas River, and 75,000 cfs. between Baton Rouge and New Orleans. Throughout the first named reach, a distance of 390 miles, a 9-ft. navigation depth was maintained only by the concerted efforts of nine dredges which moved a total of 29,000,000 cu. yd. of sand in doing so. By contrast, in the 223-mile stretch below Baton Rouge, the minimum depth during the same period was 35 ft., without any dredging. In addition, the water surface slope in the upper reach was 0.43 ft. per mile, while that of the lower reach did not exceed 0.01 ft.

From these studies and from studies made at the Waterways Experiment Station, it was concluded that the principal need in open-river navigation is to counteract the influence of the erodability of the river's banks.

In a paper on alignment of rivers as it affects open-channel methods of improvements, Capt. J. J. Friedkin, U. S. Army Engineers, Vicksburg, Miss., described the "ideal alignment" for open-channel navigation on an alluvial river as one consisting of a continuous series of bends having approximately the mean curvature of the various shaped bends on that river.

On the lower Mississippi River, the bends of this curvature have a three-mile radius, and bends having a radius up to five miles do not appear objectionable. Such an alignment would most nearly fit both the low and high flows, thus minimizing the instability of the channel resulting from changes in river stage.

ENGINEERS USE BLIMP FOR SEWER SYSTEM SURVEY

A U. S. Navy blimp was used recently by engineers in Orange County, Calif., while they were making a survey for a proposed sewage disposal system.

Resident Engineer Ewald Lemcke explained that the blimp was chosen because of its ability to move slowly and because it can hover almost without movement to permit engineers to observe and photograph industrial development and coastline topography.

Iron pipe shortage bars Los Angeles water jobs

The Los Angeles Department of Water and Power has announced that, due to a critical shortage of cast iron pipe, it will not accept further orders from subdividers for installation of water mains until current orders are filled and adequate supplies of pipe again are available.

The action was taken on recommendation of General Manager Samuel B. Morris, who reported that the department has a backlog of orders from 100 subdivisions which require 245,126 ft. of pipe, while present stocks total only 78,500 ft.

"For a number of months subdividers have been informed at the time they paid their deposits for water main installations that the department was short of pipe and no promise could be made as to the time the installation could be completed," Mr. Morris said.

"Previous to this, and before it was realized that pipe supplies would diminish rather than increase, a large number of orders for extensions had been accepted. In order that subdividers will not have erroneous ideas as to the pipe supply situation, it seems best to adopt a policy that all further orders for water main installations be refused until cast iron pipe again is available in adequate quantities," he added.

The moratorium on extensions applies to tracts only.

Labor statistics bureau sees building work drop

Construction activity began to level off during September, after climbing steadily during the last year, the Bureau of Labor Statistics reported last week in a preliminary survey.

The report said that employment of 2,307,000 workers, and expenditures of $1,243,000,000 during the month for work put in place were slightly below August levels, and activity in most types of projects either remained the same or declined slightly. The survey indicated, however, that such a decline was not abnormal for the season, although materials shortages were a contributory factor.

Reflecting the same trend—but showing a more marked decline—were *Engineering News-Record's* construction activity figures for the last three months.

However, the *ENR* weekly moving average for August was $115,000,000, which declined to $92,000,000 in September, and is expected to fall to about $90,000,000 for October.

Harbor work in prospect at Tacoma and San Diego

The port commission of the city of Tacoma, Wash., recently awarded a contract to the General Construction Co. of Seattle for reclamation of 300 acres of tidelands with material dredged from the Sitcum waterway.

Work on the $284,000 project is to start by mid-October. The commission will advance money for the dredging. The area to be reclaimed is at present 6 to 14 ft. below street grade and has been filled in partly with material dredged by the Navy recently from other waterways.

The reclamation of the land is expected to speed industrial development of the city by providing a new piece of usable land with frontages on the harbor.

The possibility of providing a second entrance to the Harbor of San Diego, Calif., by cutting a channel through the Coronado Strand will be studied by United States Army Engineers late in November, the San Diego Harbor Commission has revealed.

A resolution adopted in the last session of Congress authorized the engineers to investigate the feasibility of the new channel entrance.

While touring the harbor area in 1935, President Roosevelt suggested the possibility of a new channel through the narrow strand. A commission conducted an informal hearing on the proposal shortly before the war, and the cost was estimated then at $10,000,000. It is the harbor commission's opinion that the project now will probably run to $15,000,000.

Plan closing N. Y. airport as filled surface sinks

Because the surface of LaGuardia Field—New York City's only major air terminal—is sinking at the rate of about six inches a year, the field will have to be closed for repairs within the next two years, F. G. Reinicke, commissioner of marine and aviation, said.

In operation for the last six years, and already taxed beyond capacity to handle increasing air traffic, the field has been sinking steadily until one end of it is already under water at high tide, Mr. Reinicke said, and the entire field may be awash within two years. The surface, which was filled with garbage from a nearby dump in 1939, without bulkheading, has already dropped some five feet. Several of the airport buildings have been supported on jacks for several years to prevent serious weakening of the structures.

West coast utility plans $31 million projects

The Pacific Gas & Electric Co. has filed application with the Federal Power Commission for a license for an estimated $31,330,000 of work as a single project in a hydro-expansion program in California.

The project is one of a series of constructions and improvements recently announced as under way or planned by the company in a $160,000,000 expansion.

Three power plants on the north fork of the Mokelumne River are included in the $31,330,000 estimate. A new 44,236-hp. Lower Bear River plant would include a main dam 260 ft. high and an auxiliary dam 45 ft. high across Bear River, making a reservoir to hold 46,000 acre-ft. of water. At West Point plans call for construction of a power house with a 20,107 hp. unit. An Electra powerhouse would replace an existing 26,810 hp. plant with one of 132,708 hp. The three plants would be used in serving central and northern California, including San Francisco, Oakland, Sacramento and Berkeley.

Major projects in the expansion include:

Pit No. 1 Powerhouse on Pit River—improvement of regulating facilities to increase the peak load capacity by more than 42,000 hp., $940,000.

Potter Valley Powerhouse on the Russian River—increasing the plant's peaking capacity by 5,630 hp., $75,000.

Kern Steam Plant at Bakersfield—construction of 100,500 hp. steam operated generating plant, $12,890,000.

Eureka Steam Plant—additional facilities at Station B, Eureka, to add 12,567 hp., $478,000.

Salt Springs Powerhouse on the Mokelumne River—expansion of storage capacity of Salt Springs reservoir by about 9,500 acre ft., $330,000.

Henderlite resigns from La. highway department

Harry D. Henderlite, chief engineer of the Louisiana State Highway Department, and one of the four regional vice-presidents of the American Association of State Highway Officials, has resigned and will enter private practice at Baton Rouge. Mr. Henderlite had been connected with the highway department since 1929.

Norman E. Lant has been appointed provisionally to succeed Mr. Henderlite subject to a civil service examination. He has been chief bridge engineer for Louisiana for the last 24 years. He is a Purdue graduate.

OBITUARY

Charles Alfred Paquette, 74, died recently at Sturgis, Mich. A graduate of Notre Dame in 1891, he spent most of his engineering career in railroad work. In 1924 he resigned as chief engineer of the Big Four Railroad to become president of the White Construction Co., contractors, Chicago. At the time of his death he was president of the Paquette Engineering Corp.

Archer F. Breed, 68, civil engineer, died recently in California. He was graduated from the University of Maine. He also received an engineering degree from the University of Charlottenberg, Germany.

Lieut. Col. Harold B. Stuart, 57, veteran of both world wars, and former district engineer officer for Military District No. 2 of the Canadian Army, died at Ottawa Oct. 14. A graduate in civil engineering of the University of Toronto, Colonel Stuart was for many years connected with the Hamilton Bridge Co., Ltd., at Hamilton, Ont.

Frank E. Heames, Sr., 59, general superintendent of Commercial Shearing & Stamping Co., Youngstown, Ohio, who went to England in 1942 to help the British make Bailey bridges, died Oct. 15. He was a member of the Society of Military Engineers.

George G. Routledge, 76, engineer in charge of the water distribution section of the department of works, Toronto, Ont., for over thirty years, died at Aurora, Ont., Oct. 23. A native of England, Mr. Routledge served with the city engineer of Paisley, Scotland, before going to Canada in 1912. He joined the staff of the city of Toronto and shortly was made engineer in charge of water distribution, which post he held until his retirement two years ago. He had been awarded the Hunt Medal of the Canadian Section of the American Waterworks Association.

J. Albert Schroeder, 64, Piqua, Ohio city engineer for 16 years, died Oct. 24.

Herman G. Pfaender, 85, former member of Pfaender Brothers, Toledo, Ohio, general contractors, died Oct. 14.

William A. Johnston, 83, Akron, Ohio engineer, died Oct. 16. Many years ago he surveyed and laid out Barberton, Ohio. He also was engineer on the Akron-Barberton Belt Line Railroad project.

St. Paul, Minn., to vote on $11 million bond issue

On Nov. 5 St. Paul, Minn., will vote on a proposed $11,612,000 bond issue for improvements recommended by the local improvement coordinating committee which has based its report on suggestions made by the City Planning Board and other organizations.

A breakdown of recommendations is as follows: Schools, $4,530,000; libraries, $207,000; streets and highways, $3,000,000; sewerage $2,500,000; rivers and harbors, $300,000; workhouse, $450,000; street lighting $200,000; parks, $75,000; playgrounds, $175,000; fire department repair shop, $150,000; and enlargement of juvenile detention section, $25,000.

The committee suggested that, if the projects are approved, only those that do not compete with home building be started, but said that the work might furnish employment at some future slack period in the building industry.

Calendar of Meetings

NATIONAL

American Public Health Association, 74th annual meeting, Cleveland, Ohio, Nov. 11-15.

American Welding Society, annual meeting in conjunction with the National Metal Congress and Exposition, The Ambassador, Atlantic City, N. J., Nov. 17-22.

Highway Research Board, 26th annual meeting, National Research Auditorium, Washington, D. C., Dec. 5-8.

National Society of Professional Engineers, annual meeting, Atlanta-Biltmore Hotel, Atlanta, Ga., Dec. 7.

American Association of State Highway Officials, annual meeting, Biltmore Hotel, Los Angeles, Calif., Dec. 17-20.

REGIONAL

American Water Works Association, Iowa Section, first reorganization meeting, Hotel Kirkwood, Des Moines, Iowa, Nov. 4-6.

American Water Works Association, New Jersey Section, Chelsea Hotel, Atlantic City, N. J., Nov. 7-19.

The Associated General Contractors of America, Inc., Carolinas Branch, 26th annual convention, Sheraton Bon Air Hotel, Augusta, Ga., Nov. 10-12.

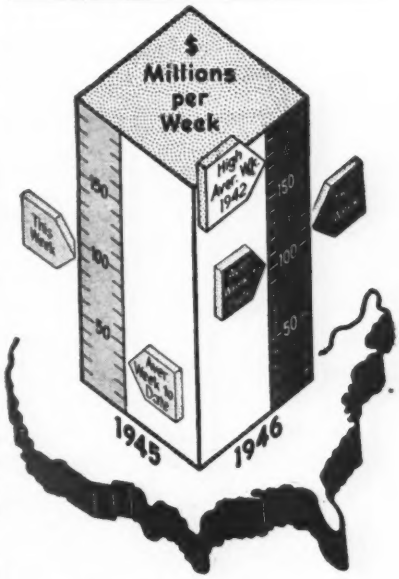
Southeastern Association of State Highway Officials, annual meeting, Tutwiler Hotel, Birmingham, Ala., Nov. 12-13.

American Water Works Association, Virginia Section, John Marshall Hotel, Richmond, Va., Nov. 14-15.

American Water Works Association, Wisconsin Section, Northland Hotel, Green Bay, Wis., Nov. 15-17.

American Water Works Association, North Carolina Section, Hotel Caroline, Raleigh, N. C., Nov. 18-20.

CONSTRUCTION ACTIVITY



As Reported this week to . . .
Engineering News-Record

CONTRACT VOLUME

Continental U. S. Only
(Thousands of Dollars)

	Week of Oct. 31 1946	Cumulative 1946 (44 wks.)	Cumulative 1945 (44 wks.)
Federal	$3,765	$558,328	$704,634
State & Mun.	30,530	1,236,654	311,468
Total Public	$34,295	$1,794,982	$1,016,102
Total Private	75,090	2,776,636	807,386
U. S. Total	$109,385	$4,571,618	$1,823,488

WHERE CONSTRUCTION ACTIVITY ORIGINATED THIS WEEK

Dollar Volume (Thousands)

Type of Work	This Week	Cumulative 1946 (44 wks.)	Cumulative 1945 (44 wks.)
Waterworks	$1,719	$95,625	$49,848
Sewerage	2,665	96,416	29,367
Bridges	4,042	115,199	36,193
Highways	18,139	681,026	191,621
Earthworks, Waterways	3,511	319,902	47,003
Buildings, Public	2,594	342,683	432,438
Industrial	34,298	940,313	458,250
Commercial	39,796	1,661,240	250,139
Unclassified	2,621	319,214	328,629

NOTE: Minimum size projects included are: Waterworks and waterway projects, $22,500; other public works, $40,000; industrial buildings, $55,000; other buildings, $205,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1946 (44 wks.)	Cumulative 1945 (44 wks.)
NON-FEDERAL	$1,281,126	$669,033
Corporate Securities	358,047	170,496
State and Municipal	698,079	334,937
RFC Loans	.....	24,600
REA Loans	.....	60,000
Fed. Aid Highway	225,000	79,000
FEDERAL	1,672,982	1,049,898
Total Capital	$2,954,108	$1,718,931

ENR INDEX NUMBERS

Index Base = 100		1913	1926
Construction Cost	Oct. '46	360.94	173.50
Building Cost	Oct. '46	272.74	147.43
Volume	Sept. '46	223	98

EDITORIALS

VOLUME 137 NUMBER 18

October 31, 1946

Housing Goals Need Revision

CASES CONTINUE TO MULTIPLY of emergency housing proving to be too expensive for veterans, and evidence grows that (1) the veteran wants to rent rather than buy and that (2) he needs an apartment, old or new, more than a new house. The situation can be remedied only by a revision of housing goals, combined with some drastic procedural changes. In our Oct. 3 issue the removal of price controls on building materials was urged to get costs out of the black-market range and to stimulate production, while in the issue of Oct. 17 it was suggested that purchase priorities be redirected to assure quick completion of houses already started and now stymied because of materials shortages. There is still another change, more in the realm of policy than procedure, but no less important for that fact, that needs to be made if the high purpose and sincere efforts of Wilson Wyatt, the housing administrator, are not to be wasted. This is the complete divorcement of the emergency program from the long-term objectives of the National Housing Administration. Preoccupation with promotion of prefabricated housing and with the desire to bring about consolidation of all federal housing agencies under one management has diverted attention and effort from the real trouble with the emergency housing program—lack of materials and resulting high costs. Housing goals should be revised to concentrate on a quick increase in the supply of housing and not on means of revolutionizing the house-building industry, however much this may be needed. Moreover, realistic housing goals would include more apartments to rent and fewer houses to buy, and they would avoid the shibboleth of low-cost housing for veterans and take in housing for everybody.

Higher Society Dues

AT ITS RECENT MEETING, the board of the American Society of Civil Engineers decided to ask the members to authorize an increase in dues, which have remained at the same level for 25 years. Increases in the cost of the society's long-established services to its members and increasing demands for new services are the reason. Similar action was taken not long ago by the National Society of Professional Engineers and the constituent state societies. Such increases appear to be an inevitable result of the growing group consciousness of engineers and their desire to be heard on local, national and international issues of engineering interest. Such organizations as the Inter-American Association of Sanitary Engineering, set up recently in Caracas, or the international engineering congress that was projected in Paris in September cannot carry on without financial support, and it is obvious that the Engineers Joint Council will need more funds if it is to continue to function effectively. In agreeing to meet these higher necessary charges for society services, engineers will naturally expect that all duplications of services as between societies be carefully weeded out. To this end, as well as to effective use of increased revenues, society administrative bodies will need to bend their efforts.

Courage and a Controlled Economy

THOSE WHO HAVE VISUALIZED a federally controlled economy as an easy solution for many of our problems should reflect upon last week's announcement of the Office of War Mobilization and Reconversion that the limitation of $900,000,000 on federal construction imposed by the President's economy order of Aug. 5 cannot be held. In revising the total upward to $1,200,000,000, the OWMR carefully explained that it will involve only a small increase in actual expenditures in fiscal 1947. The fact remains that official courage was not equal to political pressures and the economy lid slipped off. The significance is obvious. Federal controls are political controls, and they respond to politics and not economics.

Deserved Recognition

SO MANY THINGS trouble the building industry—obsolete codes, restrictive manufacturing and labor practices, skimped and careless field work—that more than ordinary satisfaction can be taken in the citations awarded to pioneers in modular design at the recent annual meeting of the Producers' Council. In giving the citations, the organization honored itself as well as the fourteen architects, engineers and building-material specialists, for it was this association of manufacturers, in company with the American Institute of Architects, which sponsored

the work of Committee A62 of the American Standard Association in making dimensional coordination practical. Many useful attempts at standardization of building products had previously been recorded, but they accomplished only a reduction in the number of sizes of units manufactured. Dimensional coordination hits at the fundamentals of the problem by standardizing a unit of measure that can be applied to all products. Manufacturer, designer and builder are served simultaneously and permanently. Moveover, the adopted module of 4 inches, stemming from the classical stud and joist spacing of 16 inches, requires practically no change at all in existing building practices. With brick, tile, wallboard, windows and several items of installed equipment already modulized, progress is substantial. The best promise for the future rests in the fact that manufacturers, designers, and users can mutually exert pressure on one another for extension of the procedure. And as this happens, the honors that have come to the present pioneers in dimensional coordination will be even more deserved.

Engineers and the Military

FOLLOWING CLOSELY on the heels of a job well done—that of rendering all-out technical and scientific assistance to the military during World War II—engineers and scientists at the recent Kansas City meeting of the ASCE heard Maj. Gen. H. S. Aurand, director of research and development, U. S. War Department General Staff, plead for a peacetime continuation of similar aid and assistance in the interest of national security.

Specifically, General Aurand urged engineers, scientists and their respective organizations to be prepared for prompt, speedy and complete mobilization in the event of another war. In the meantime, he urged them to establish separate bodies to aid the military in studying long-range problems of national security, and to arrange for a more rapid application of scientific information to military needs should a future emergency arise.

In recent months civil engineers and construction men have had specific notice of the demands from the military for their knowledge and services. Contracts and proposals for contracts covering military developments at such outposts as Hawaii, the Philippines, Guam, Wake, Okinawa and Guadalcanal already aggregate in the neighborhood of $100,000,000. In Alaska and in the Aleutians, particularly Adak and Attu, development contracts may soon reach $50,000,000. Studies looking toward major changes in the Panama Canal are under way, and there have been proposals for work at the Caribbean bases.

Here at home consulting engineers have been engaged to select sites for great military research establishments, and .there was reported in this journal last week the construction of facilities in Maryland to house the captured supersonic wind tunnels that the Germans used to develop their V rockets. In this latter connection there was also the recent inquiry as to possibility of securing a block of two million kilowatts of power (almost as much as serves the entire city of New York) for other supersonic wind tunnel research. Thus evidence is nowise lacking that the partnership of the engineering profession and the military, born of the war, is still in active operation.

Abroad this same striving for security by way of construction is plainly apparent. Russia's large military budget, and small bits of information as to its allocation, reveal her dependence on the talents of construction workers. And only last week the British Colonial Office unfolded a plan for a great African development—ports on the east and west coast joined by airfields and a 4,000-mile highway traversing that continent's midriff of desert, swamp and mountain.

Nowhere in the world—for even in the defeated nations occupation forces are actively utilizing the fruits of construction activity—is there a letup on military preparedness. And whether it is expressed by troop housing, airfields, ports, or radar and rocket research, it involves the services of civil engineering and construction. If war should come, these services will be in even greater demand. Ivan C. Crawford, dean of engineering, University of Michigan, expressed it accurately before a group of engineers in Chicago last week when he declared that "in the event of a future national emergency, the engineer will be the main support of our military effort." The best preparation for such a role is active collaboration with present military security planners, the fruits of which may, in fact, assure peace and avert a universally feared war.

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WALDO G. BOWMAN, *Editor*, EDWARD J. CLEARY, *Executive Editor*.
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EDITORIAL OFFICES: 330 WEST FORTY-SECOND STREET, NEW YORK N. Y.

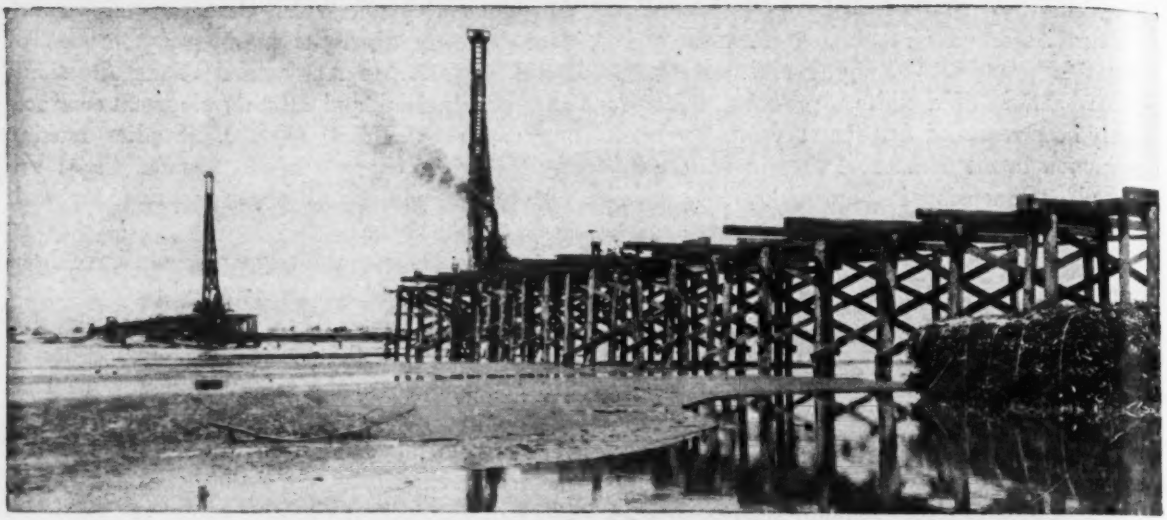


Fig. 1. Pile trestles were built out from opposite sides of the closure area to facilitate the work of completing the dike.

Turning Back the Yellow River To Its Prewar Channel

Oliver J. Todd
Adviser to the Yellow River Commission
United Nations Relief and Rehabilitation Administration
Chengchow, China

***Editor's Note**—When word was received in this country that Oliver J. Todd had returned to China and was directing the unprecedented undertaking of turning the Yellow River back into its former channel, the editors sent him a request for an account of that operation. The request reached him when he was too deeply involved in preparing for the approaching flood to reply; but after the peak of that work had past he sent by air mail the following account of what was accomplished before the floods came and what is planned to complete the undertaking. Mr. Todd writes that in addition to floods, both political influence and actual civil war have slowed up the work, but that the engineers are quite well satisfied with results. Over twenty years of experience in fighting floods on rivers in China lie behind Mr. Todd's direction of the current river diversion work.*

Now that the war with Japan is over, China is anxious to have the Yellow River back in its old bed—the bed it was in for 85 years prior to 1938, when military necessity compelled cutting the south main dike near Huayuankou 10 miles east of the Peking-Hankow Ry. bridge and 13 miles northeast of Chengchow, Honan Province.

That dike cutting in June, 1938, caused the full flow of the Yellow River to take a new course to the southeast through eastern Honan, Anhwei and Kiangau provinces. During the eight years it has followed that course there has been no well defined channel established whereby the flow was kept within dikes of adequate size and properly spaced. Instead it wandered over a broad territory and inundated farm lands estimated at 2,000,000 acres. It usurped the Hwai River system, taxing it beyond its limits, and has poured silt and sand deposits into the upper reaches and tributaries of that river. This has aggravated the flood situation in the lower Hwai River valley each summer since the diversion of 1938.

Because of these conditions, the Chinese government requested aid from the United Nations Relief and Rehabilitation Administration in reclaiming this central China farming area that has been flooded by the Yellow River. The first part of such a program is to revert the flow of the latter stream to its former channel and repair the dikes system of that old channel. It was decided to do that this year.

The officials of both UNRRA and CNRRA (China National Relief and Rehabilitation Administration) wished to have the change in flow effected before midsummer, and bent strong effort toward such an early accomplishment in order to get the flooded lands back into crop produc-

tion as soon as possible. But political complications, including indemnification to dwellers on lands of the old river bed and payments for large scale dike improvements proposed for Shanting Province, as well as objections to cutting this summer the railway that runs across the old river bed northwest of Kaifeng, caused delays in the program.

Consequently, only partial diversion was agreed upon for this summer, and this only for peak flows. The complete diversion is planned for the autumn when the summer floods have receded. This work may take until the end of December, depending on the rapadity of recession of the flood stage during September and also upon the political condition of the country that will effect the haulage of rock from quarries 60 miles away for the main fill of the closure dam.

Plans for the immediate control of the Yellow River flood included diversion of the river back into its course preceding June, 1938, by means of a closure of the dike break of eight years ago. In addition, it was planned to do as much in repairing the dike system of the old Yellow River channel as would be found necessary to put the main dikes into as good condition as they were in 1938 and also to raise these dikes sufficiently to take care of such change in channel capacity as had been caused by siltation during the small overflow periods of the past few years.

Plans for the closure dike

The engineers, both those belonging to the Yellow River Commission and the UNRRA staff, agreed on a plan for closing the 5,000-ft. long opening through which the Yellow River has been flowing for the past few years. The scheme adopted called for an earth dike from the west end of the break about 3,800 ft. long and a pile trestle from which a rock-fill dam would be constructed for the remaining 1,200 ft.

Fear on the part of the Chinese engineers lest the work could not be completed before the high water of 1946 subsequently caused them to alter the plans so that the main earth closure dike was limited to about 3,400 ft. in length, thus extending the length of the trestle to 1,600 ft.

Work on the project was begun about March 1, using old Chinese methods due to the lack of modern equipment. But by April and May, American equipment shipped in by UNRRA began to arrive and soon dump trucks were supplementing wheelbarrows and baskets in handling earth.

Eight-mile railway built

Also, a railway about eight miles long was built to connect the main closure dike with the Peking-Hankow Ry., partly for the purpose of bringing in heavy foreign equipment, including material for 25 60-ton barges, piles, and trestle timbers, and partly for hauling 60,000 to 70,000 cubic meters of rock that was estimated as necessary for the rock-fill dam and facing of the earth section of the closure. This railway was constructed with considerable difficulty, sidings of the connecting lines being robbed of steel and ties at odd places. However, it was in use by late April.

A good limestone quarry was opened up at a point nearly 60 miles by railway, north of our project, with air-compressors and pneumatic drills and an American operator in charge. This quarry has been operating successfully and has furnished the job with such quantities of rock as the railway could be induced to deliver. There was a shortage of trains and coal to supply the locomotives for hauling this rock, so that at no time was there sufficient surplus to guarantee a diversion of the river during the summer. Military movements have caused this shortage of locomotives and trains, and while civil war conditions continue the engineers will be handicapped.

Although the heavy timbers, piles and the piledrivers which were shipped from Portland, Oregon, in February did not reach the job until early May, the trestle was completed on June 21, with some excellent records of pile driving near the end.

The piles were driven in bents,

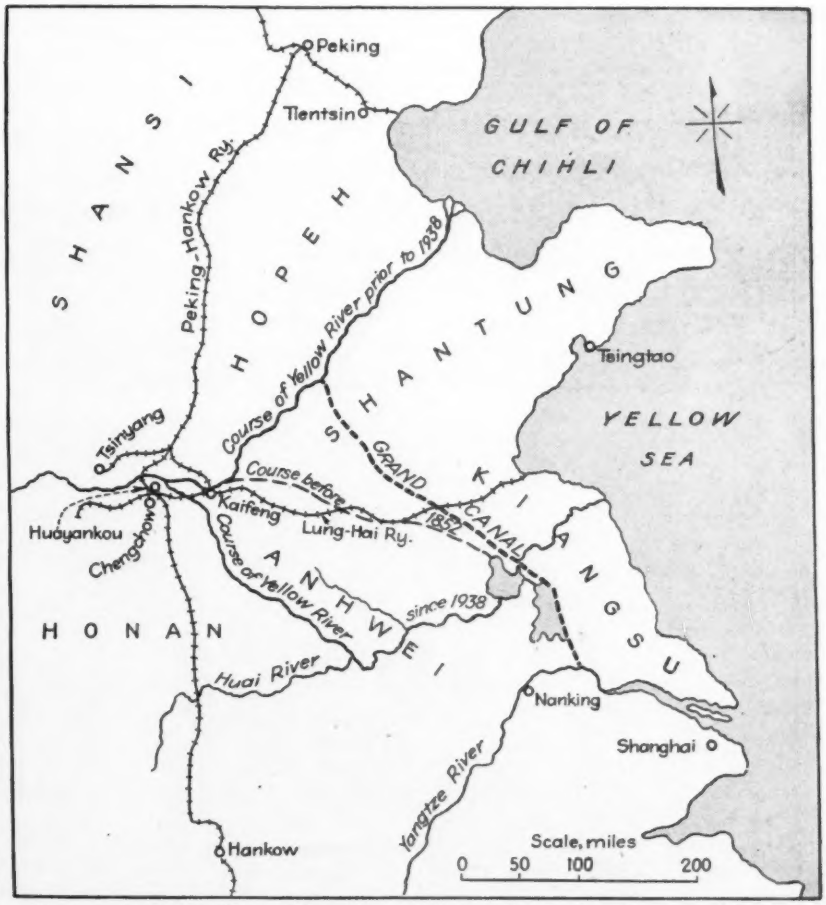


Fig. 2. In 1938, the Yellow River dikes at Huoyuankou were cut to turn the river into the valley of the Hwai River to cause floods that would check the Japanese. Now the river is being returned to the channel it occupied prior to 1938.

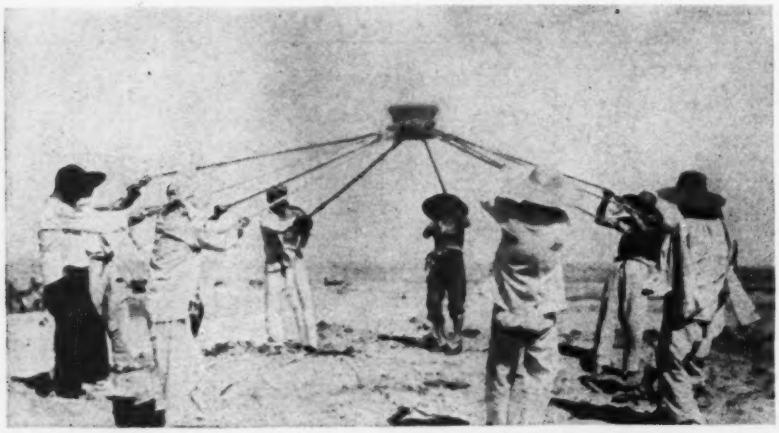
spaced 10 ft. apart at first, and later increased to 13 ft., with 12 x 12 in. Oregon pine caps fastened to them with long ⅞-in. iron spikes. On these a floor of 6 x 12 in. timbers was placed; stiffening was done by cross-bracing using ½-in. bolts and 3 x 12-in. timbers. The piles were driven to a penetration of 30 to 40 ft. into the sand and silt bed of the river.

For all moderate flows of the river this working trestle was a very stable structure; it was built to handle dump cars pushed by hand on 24-in. gage track bringing in rock from the ends of the trestle, as had been done in a similar structure near Litsin, Shantung, in 1923 under the direction of the writer. While in the 1923 closure a flow of 15,000 to 20,000 cfs. had to be dealt with and the trestle was only 800 ft. in length, in this instance the flow at the time of the completion of the trestle was approximately 35,000 cfs. and within a week it had jumped to 200,000 cfs., which was far too great to be dealt with in a closure of this type.

This high water of June 29 carried out the Lung-Hai Ry. trestle across the Yellow River 25 miles downstream between Chengchow and Kaifeng. It broke off about twenty bents of our trestle at the closure at Huayuankou.

A later flood on July 20 and 21 broke off additional bents. (Heavy vibration induced by strong flood flows caused piling to break at 12-in. diameter; few were undermined). However, starting immediately after the completion of the trestle, such rock as could be obtained was dumped from the trestle along the first 1,000 ft. from the west end and this continued at the rate of about 800 cubic meters per day until that portion of the trestle was thoroughly stabilized. This portion of the rockfill dam, which is now a submerged weir, will be the part of the closure which will be used in the final stages of reversion of the flow of the river in November and December next. It is in excellent condition and has held its position well despite velocities of 10 to 12 ft. per second.

Of the 5,000-ft. gap between the two ends of the old dike, only 500 ft. remains now uncontrolled. This will be filled during the low water period in the late autumn after siltation has reduced the present depths, which are as great as 30 ft. Whether other piles will be redriven and the working trestle extended for the use of push cars to deliver the stone in place or whether the new 60-ton barges just constructed will be used for delivery of rock to this 500 ft. of now uncontrolled gap has not yet been decided by the Yellow River Commission authorities. It may be that the new barges now under construction will handle a portion of the rock more economically than would be the case if tramming by hand on small push cars were adopted for distances exceeding 1,000 ft. The lower cost method will be adopted after some experiments have been made.



Old and new methods fused

In this closure work Chinese and foreign methods have been fused. The Chinese use a great deal of kaoliang stalks and willow branches in facing their earth dikes. These are tied back

Fig. 3. Ancient hand methods were used in building the dikes before modern equipment was received. Above is shown the Chinese method of obtaining maximum soil density. Below, hundreds of laborers are employed in moving earth and kaoliang into one of the large dikes.

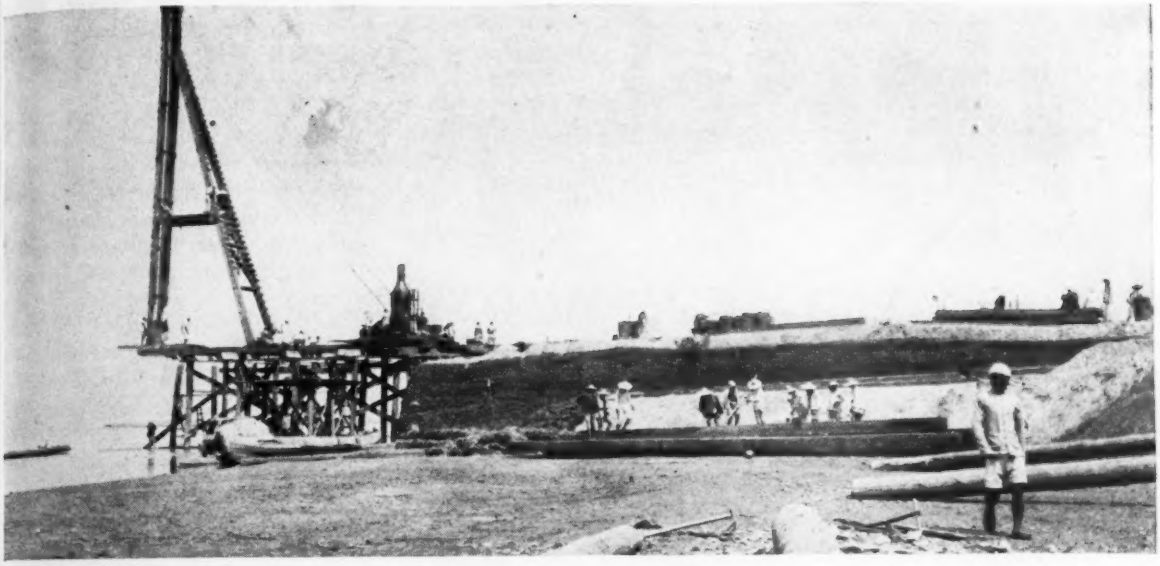


Fig. 4. In making the closure, an earth dike faced with kaoliang was built out from the existing dike to close part of the opening completely, then a trestle was driven across the remaining open channel.

with ropes made on the job from native hemp and fastened to willow stakes. All this material is obtained locally and hauled in from distances as great as 60 to 70 miles on very primitive carts with solid wooden wheels drawn by oxen. No modern mechanical equipment is used to bring this material to the job and it is placed as it has been placed for many centuries past.

The supply of rock for securing the toes on the river side of such revetment has been more generous on this project than in other closures made in the past, and rock has been used freely to weight down the willow and kaoliang work in the projecting groins built out into the river as safeguards for the long earth closure section.

The equipment furnished by UNRRA for this project included 2 large piledrivers, 3 unloading cranes, 12 bulldozers, 3 sheepsfoot rollers, 4 tandem road rollers, 2 road graders, 2 power shovels and 2 "ducks" or amphibious jeeps, which proved unmanageable on the soft muddy shores of the Yellow River. To these should be added the automobile equipment consisting of 25 jeeps, 15 weapons carriers, 5 cargo trucks and 50 dump trucks. Not all of this equipment was used extensively; the piledrivers, the dump trucks and unloading cranes and the power shovels all proved very effective and were appreciated by the

Fig. 5. New dikes such as the one shown in Fig. 4 are protected against erosion by a revetment of kaoliang stalks, packed down and tied together with crude ropes made of native hemp.

Chinese in times of emergency when hand labor could not be substituted for them. The jeeps and weapons carriers were indispensable in getting over the job to move staff for supervision of work.

Dikes to be repaired

In the matter of dike repairs, three provinces were concerned, Honan, Shantung and Hopei. In view of the fact that UNRRA's arrangements have been with the National government of China, there were many delays in getting into Shantung province where the Communist party was in almost full control of the Yellow River region within its borders, and it was late May before a working agreement was effected with the Shantung authorities; but during the month of June and in early July, a working force of nearly 400,000 men was assembled in that province for the purpose of doing the earthwork necessary to repair the Shantung dikes to a condition of moderate safety. This included most of the work required in Hopei province, which is Communist occupied, and was done by the Shantung authorities. Probably 50,000 men were put on the Honan dikes during late June and July so that by midsummer most of the necessary earthwork had been completed.

The vital question of indemnifying the people who had been living in the Yellow River bed and raising crops there for the past seven or eight years was not settled until July 22 after a series of conferences in which Chinese National government officials,

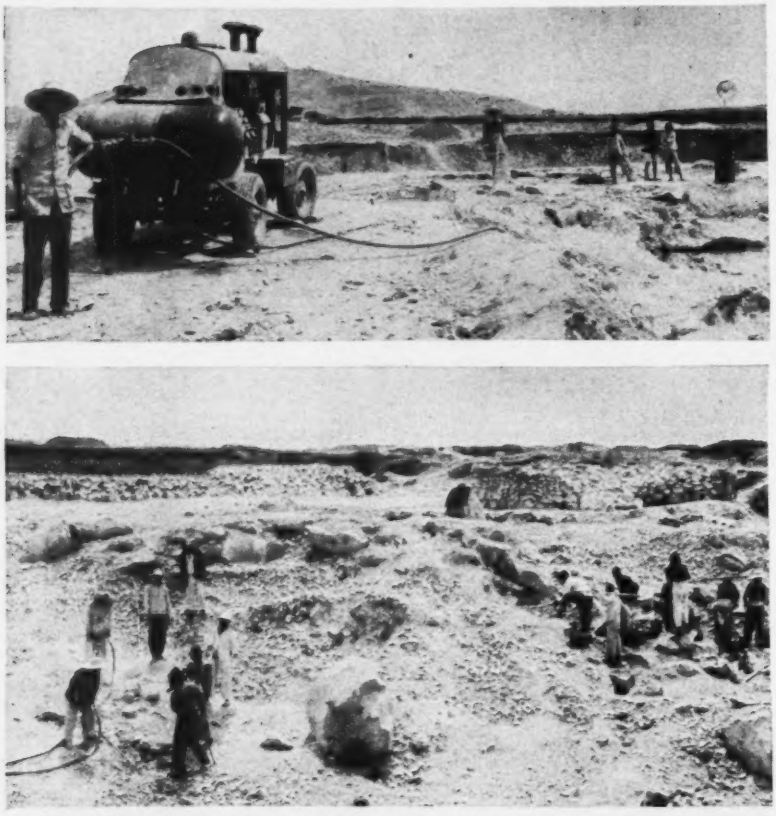


Fig. 6. Rock for the dike across the main channel was obtained from a quarry 60 miles from the job. American air compressors and rock drills were used, being in charge of an experienced American operator.

Communist officials, heads of CNRRA and heads of UNRRA, took part. It was then agreed that all factions would cooperate in a united program to be outlined by the engineers of the Yellow River Commission, commencing work not later than September and completing the diversion of the river to its northeastern course through Shantung by the end of the year.

Unless present disorders extend their scope seriously, this program can be carried out on time. The Yellow River Commission has recently been reorganized with a graduate engineer, K. T. Chu, at its head. It now bears the title of Yellow River Engineering Bureau and will have charge of all work connected with completion of the program of putting the Yellow River back into its old course and properly safeguard the dike system from the closure site at Huayuankou on to the sea.

With all the pioneer work of this project completed and quarries operating so that they will produce 1,000 cubic meters per day, with good railway connections from quarries to the closure, with 1,000 ft. of submerged weir laid so that the river bed is stabilized in all but 500 ft. of the opening, and with both ends of the break well revetted with willow and stonework, the task of complete closure and turning of the flow of the river back into its former course presents no major difficulties. The job of waterproofing it towards the end of the year is one that can be handled with no great trouble. Under the present organization, no new technical problems should arise that will in any way delay final closure. Prompt haulage of rock from quarries to site at the rate of 800 to 1,000 cubic meters per day, starting early in September, will be the essential factor in completing the entire project on time.

It should be added that during the crest floods of July 20-21, when between 500,000 and 600,000 cfs. came down the river, the closure work done to date caused a flow through the old channel of 4 ft. in depth along the thread of the old stream. This did not last for many hours however, but will be repeated with perhaps a still greater depth of flow should a similar peak occur before the end of high water in September.

That is the extent of the partial diversion that took place this summer despite the many obstacles placed in the way of the engineers in pushing this work through at the earliest possible date. After complete diversion this year, a program of channel cleaning and land levelling for the now flooded regions of Honan and Anhwei will be inaugurated at once under the Agricultural Rehabilitation Officer of UNRRA and his associates in CNRRA. Fall crops will be planted on a wide scale just as fast as the water runs off through the Hwai River system.

Just what damage has been done to the Hwai River channel and how much dredging will be required to put it back into its former condition for handling its own natural flow cannot be determined until diversion of the Yellow River late this year; then a suitable survey of the situation will be made and plans for improving the Hwai River will be inaugurated.

Many nationalities participate

As to the staff furnished to work with UNRRA's adviser, it should be noted that several nationalities were employed; a few came from America, one was from Canada, several Russians who had been in China for a number of years were employed by UNRRA in Shanghai, a Hollander who had been many years in China was added to the staff, and men just out of the American Navy were employed as power equipment operators. One Norwegian sea captain was employed to assemble the barges that came in large bundles of parts shipped in from America. The man in charge of the air-compressors was an American mechanic. Altogether, less than 20 foreigners were employed by UNRRA to supervise the mechanical end of the work and act as assistants to the writer. He worked, as adviser, in conjunction with the chairman of the Yellow River Commission and his subordinate staff. The chief assistant to the writer was C. C. Chang, an excellent Chinese engineer, who had worked for him six years before 1936. His services have been invaluable as an engineer, an interpreter and a co-negotiator.

Welded Frame for a 16-Story Building

A. E. Poole
The Hallen Company
Long Island City 1, N. Y.

L. F. Booth
George A. Fuller Company
New York 22, N. Y.

***Contents in Brief**—For a hospital at Hartford, Conn., about 3,000 tons of structural steel was connected by 21,000 ft. of fillet welds to provide the frame of a 16-story building. By careful scheduling a crew of nine did the necessary welding to stiffen the frame as the erection derricks were raised. The same small crew completed all of the welding in 15 weeks*

GREATER KNOWLEDGE and improved techniques of welding developed by extensive war use are being capitalized in design and construction of the structural frames for postwar buildings. An important one of these structures is the 16-story Hartford, Conn., Hospital now approaching completion.

The structure is designed simply with column loads fully axial, and consequently offered no special erection problems. A few bolts are provided in the frame, sufficient to take the weight and wind loads during erection. Some 3,000 tons of structural steel was erected and the equivalent of 21,000 ft. of ¼-in. fillet welds made in the field in 15 weeks, despite the inclement weather of February, March and April. The steel members are encased with poured concrete, and the building walls are of brick to make a fireproof structure.

Simple connections employed

Main frame columns of the same section have milled ends butted directly together and are connected by simple splice plates on the outside of the flanges. For connection between columns of varying sections, a ¾-in. butt plate was shop-welded to the bottom of the column with the smaller section. The butt plate was welded to the column by six ¼-in. by 2 in. fillet welds, two on each of the flanges and two at the centerline of the web. Splice plates also were welded to the lesser section column in the shop, using fill plates to build them out to the required clearance for connecting to the larger columns. Four erection bolt holes were provided in the splice plates and corresponding holes in the flanges of the larger section column for ¾-in. bolts. Column connections were made by ¼-in. fillet welds to the splice plates (Fig. 3).

Throughout the framework, only five types of beam connections were used, and all of these were made with standard framing angles (Fig. 2). In beams varying from 8 to 12 in. deep, two erection bolts were provided; for 14-in. beams, three erection bolts; and for beams 15 in. and over four erection bolts. In framing beams to beams, erection bolts were adequate to carry beams 10 in. and under so field welding was not required for these members.

Maximum reactions varied from 13.2 kips for 8-in. beams to 86.4 kips for 27-in. beams. Where top and seat connections were used, the bottom angles were shop-welded to the

Fig. 1. One-man crew, working without a scaffold, makes welded connection of floor framing members. Erection bolts are left permanently in the steel.

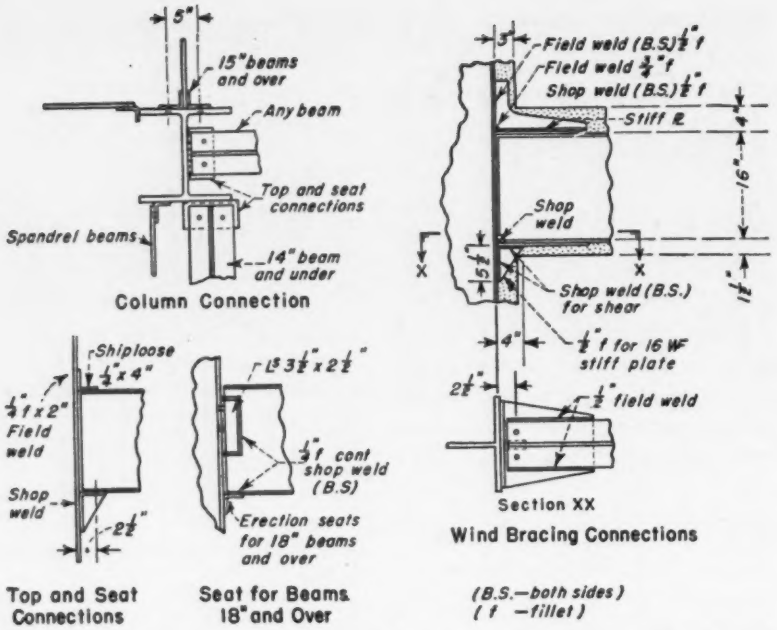


Fig. 2. The five typical connections shown at the left were adequate for most of the beams. Wind bracing, at right, was used on only a few of the beams.

column and used as an erection aid. The top angle was shipped loose and welded in the field. Beams from 8 to 14 in. in depth were connected by ¼-in. fillet welds and the 16 to 18 in. beams by ⅜-in. welds.

Wind bracing consisted of top and bottom plates on some of the horizontal beams—designed for moment, tension and shear. Stresses vary from 24 to 254 ft.-kips in moment; 36 to 190 kips in tension; and 26 to 62 kips in shear. Bottom plates were shop-welded to the column, to act also as an erection seat, and the top plate shop-welded to the beam. The field welds required to connect the bottom plate to the beam and the top plate to the column varied from ½ to ¾-in. fillet welds.

To permit centering vertical risers for utilities in walls on the column line, it was found necessary to offset many of the horizontal members from the columns by eccentric connections (Fig. 4). Some of the connection angles are welded to the face of the flanges of the main vertical member, while others are attached just to the edge of the flange. In the latter case, plates are provided between the flanges to stiffen them against buckling or bending. The ease with which eccentric connections can be made is an important feature of welded construction.

While the prime factor in the selection of welding for this building was reduced noise nuisance for patients in nearby hospital buildings, an additional advantage was that sufficient trained welders were available in contrast to an almost complete absence of experienced riveters.

Small force adequate

The welding force, consisting of a foreman welder and nine journeymen, kept abreast of the welding without delaying the raising of the derricks, and erection of the steel. It is estimated that a minimum of six riveting gangs would have been required to equal this progress. Assuming a foreman riveter and four

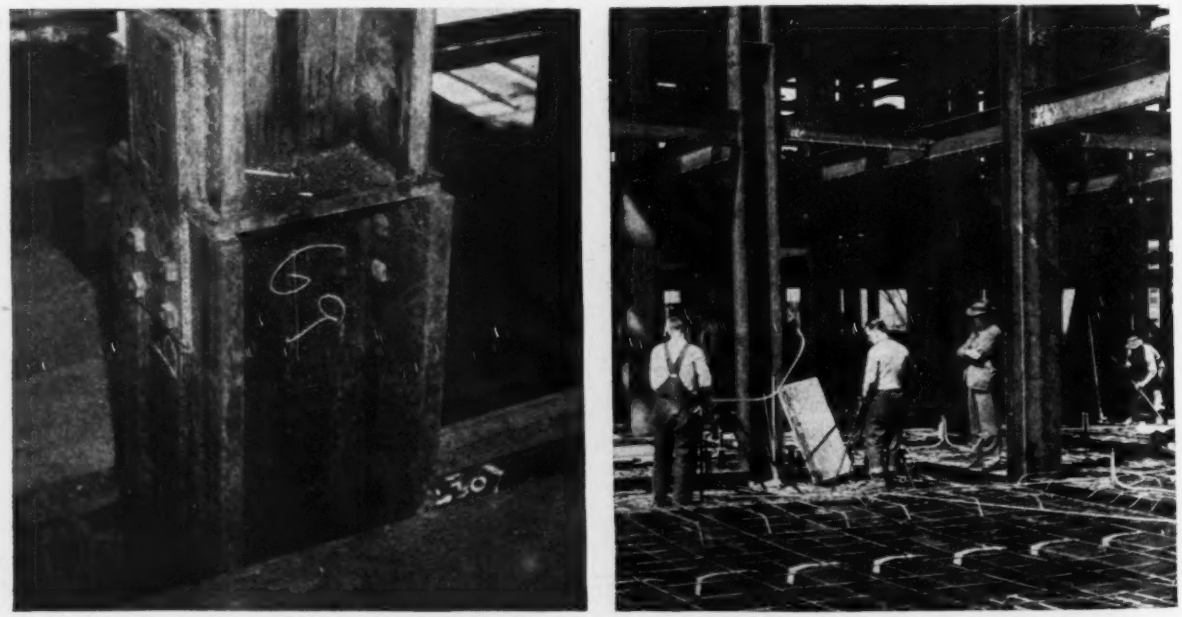


Fig. 3. Where columns reduce in cross-section a butt plate distributes the load. Column at right continues at the same size and requires only simple end-bearing splice.

men to a gang, this would have required a total force of 25.

Another advantage of welding is that in most cases it was possible for the welders to work directly from the structural members and almost completely independent of scaffolding. The same simplicity applies to the equipment necessary for welding as compared to riveting. Riveting would have required compressors, forges and much miscellaneous equipment. With welding it was necessary only to run the lead from the machine to the welder, and for the men to be provided with a sheath to carry a supply of electrodes. Shifting the welding leads from point to point is much simpler than moving riveting equipment and scaffolding material.

The welded design does not require gusset plates and does not have the projecting rivet heads and extra angles of the conventional riveted connections, thus simplifying the concrete formwork to fireproof the steel framing.

Erection procedure and problems

The erection of a welded structure is inherently faster than in the case of a riveted one, but to realize the time-saving careful scheduling is required to get the building frame plumb and the sections supporting the derrick welded to carry the erection stresses without delaying steel placing. The few erection bolts detailed are not adequate to carry the eccentric stresses of hoisting nor to give the structure the necessary rigidity.

On a riveted job the field bolting can be increased in the bays beneath the derricks, but on a welded structure the final welding must be virtually completed in the derrick areas before the erection equipment can be stepped-up. To accomplish the work with a minimum crew, welding was planned to follow the derricks up in the bays immediately under each of the derricks, and more than ordinary care was taken in plumbing and guying the rest of the frame with cables and turnbuckles so that strains and distortions from the eccentric derrick stresses were not frozen into the structure during welding.

Standard welding methods

The Hartford building code does not provide for welded construction, but it was permitted under standards of procedure approved by the American Welding Society. Operators were qualified by AWS tests including face and root bend testing of their samples. Welds throughout the entire structure were made with $\frac{3}{16}$-in. electrodes designated E6012 in the AWS code.

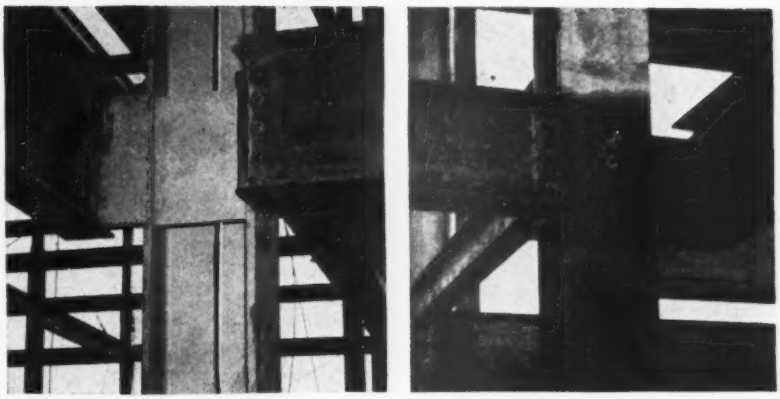


Fig. 4. Eccentric floor-beam connections at columns permit utility piping to be carried up through walls on the column line.

Ten motor-generator type welding machines were grouped in a bank on the ground outside the structure and operated from a 200-volt primary source of power. Each machine was individually grounded to the framework and the welding leads run up to the necessary height for the use of the welders.

The addition to the Hartford Hospital was designed by Coolidge, Shepley, Bulfinch & Abbott, architects, of Boston, for whom William M. Chance, Jr., is in charge at the site. The general contract for construction is held by the George A. Fuller Co. of New York and is directed by D. P. Appell, vice president, with M. J. Grogan as superintendent.

The contract for the structural frame was held by Utica Structural Steel, Inc., of Utica, N. Y., which company detailed and fabricated the steel. Erection was subcontracted to Karl Koch Erection Co., Inc., of New York and field welding was done for them by the Hallen Co., Inc., of Long Island City, N. Y.

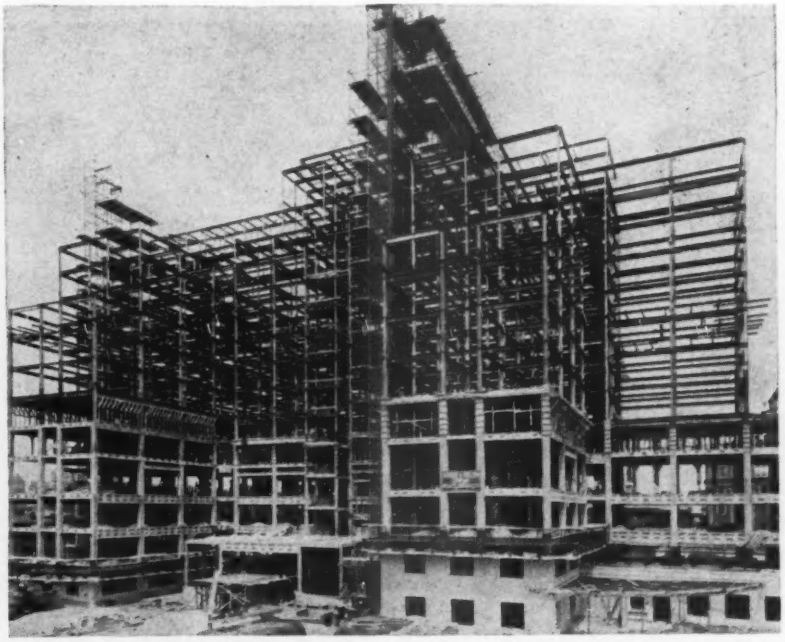


Fig. 5. Shop and field connections are welded for the structural frame of this 16-story building at Hartford, Conn.

New Goals Set for Highway Lighting

H. E. Mahan
Manager, General Electric Illuminating Laboratory,
Schenectady, N. Y.

***Contents in Brief**—Standards for highway lighting set for the National System of Interstate Highways are outlined in connection with the revised recommendations of the Illuminating Engineering Society. The types of lights that are available to meet these requirements are described and some estimates as to costs are given.*

Two recent developments are expected to have a marked effect on highway lighting: (1) The lighting needs of the projected National System of Interstate Highways, and, (2) the new "Recommended Practice of Street and Highway Lighting" adopted by the Illuminating Engineering Society.

Basic standards for the National System of Interstate Highways were set forth in the report of the National Interregional Highway Committee (House Document 379). They establish for the first time a fundamental guide for this type of illumination. In those standards, the following locations are listed as areas where adequate illumination is imperative:

1. All points on rural sections where traffic speeds must be reduced because of merging traffic or where unusual caution is required because of traffic or other conditions;
2. Transitional areas between lighted and unlighted sections;
3. All urban sections of the interregional system;
4. All connections, for such distance and in such degree as may be necessary to provide a safe transition between the freeway lighting and illumination on the connecting street;
5. Outlying limits of urban sections, with lighting levels diminishing from lighted to unlighted sections, or to sections on which the illumination is of lower degree.

These areas would include such places as the following:

1. City traffic arteries forming part of through highway systems;
2. City bypasses where night traffic warrants lighting;
3. Intercity routes with exceptionally heavy night traffic throughout their length;
4. Throughways, at least at points of entrance and exit;
5. Underpasses and overpasses;
6. Cloverleafs with medium or heavy night traffic;
7. Important bridges and viaducts.

The same areas should also be considered on regular heavily traveled highways. In addition, consideration should be given to dangerous curves

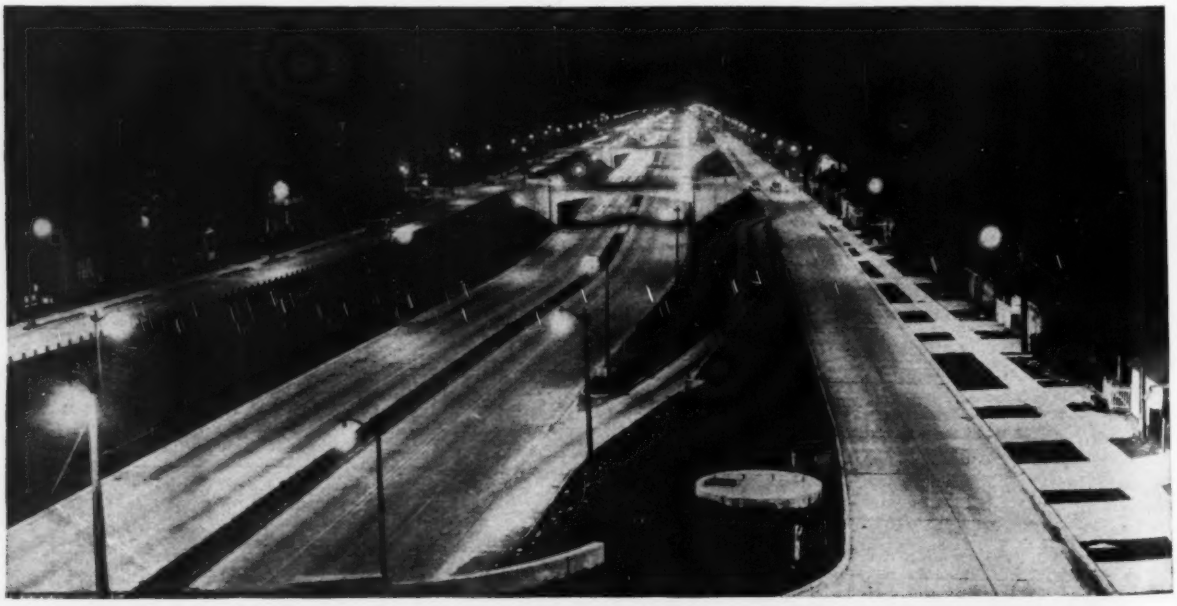


Fig. 1. The Davison Express Highway at Detroit is a good example of an adequately lighted expressway. Average pavement illumination is 0.75 foot-candles. Asymmetrical luminaires are used with 15,000-lumen series lamps and a 26-ft. mounting height. Spacing between luminaires is 100 ft., staggered.

on routes carrying medium or heavy traffic; hazardous or blind intersections; and dangerous railroad crossings not warranting underpass expenditure.

That such lighting is needed is apparent from the highway accident record of 1941, the last full year of normal car usage. During that year, only four percent of the country's entire 500,000 miles of highway accounted for more than 5,000 deaths. The most dangerous zones were largely the entrances to cities and routes through small communities along the highway routes.

A recent survey by A. F. Dickerson, manager of the General Electric Lighting Division, showed for the next ten years a minimum need of one million new fixtures (costing $150,000,000) for 25,000 miles of traffic arteries; half a million fixtures (costing $90,000,000) for 5,000 miles of freeways; and 600,000 luminaires (costing $80,000,000) for 15,000 miles of highways constituting mainly the approaches to cities and highways through villages. The savings from adequate lighting at such death traps would be many times the cost of the lighting.

Lighting standards revised

To aid in the installation of adequate illuminating levels, the Illuminating Engineering Society has just revised its "Recommended Practice" to keep pace with advances in the science and the changing requirements of our streets and highways. In the new standards, traffic safety in its broadest sense is regarded as the fundamental requirement of lighting. For the first time an attempt is made to appraise pedestrian traffic volume and introduce it as a factor in determining the illumination requirements. Thus, the table of recommended average foot-candles (lumens per square foot) is based upon the relative volume of vehicular and pedestrian traffic and not on an arbitrary classification of business streets, traffic arteries, residential streets, etc., as in the past. (See Tables I, II and III).

The new IES recommendations classify streets and highways according to traffic, such as medium, heavy and very heavy, and specify illumination levels for each condition. They also recognize the fact that most urban streets have dark pavements, while most highways have light-colored surfaces. Illumination levels are specified for this condition, with provision for modifying the stated values if desired where different pavement surface is used.

The average freeway, in general, should have about 0.8 of a foot-candle of illumination. Medium width highways require a minimum average of 0.3 of a foot-candle. Highway intersections, traffic circles and other such dangerous spots call for a minimum average of 0.4 of a foot-candle.

For urban streets, foot-candle values ranging from 0.2 to 1.2 are specified, the values being related both to pedestrian and traffic volume. For example, an average of 0.6 of a foot-candle is recommended for urban streets bearing 500 to 1,200 vehicles per hour in one direction with light pedestrian traffic. Similarly, 1.2 foot-candles are recommended for 1,200 or more vehicles an hour with heavy pedestrian traffic.

A more definite classification of light distributions than ever before appears in the new IES recommendations.

Types of lamps available

Incandescent filament lamps will undoubtedly be used for most highway lighting, due to the variety of available sizes, low cost, ease of maintenance, reliability and adaptability to efficient light control. Mercury vapor lamps, however, are coming to

TABLE I—CLASSIFICATION OF URBAN STREETS
(As recommended by the Illuminating Engineering Society)

Classification of Traffic	Volume of Vehicular Traffic (maximum night hour both directions)
Very light traffic	Under 150
Light traffic	150–500
Medium traffic	500–1,200
Heavy traffic	1,200–2,400
Very heavy traffic	2,400–4,000
Heaviest traffic	Over 4,000

It is recommended that all streets be further classified by the volume of pedestrian traffic in the maximum night hour as follows:
Light or no pedestrian traffic—as on streets in residential or most warehouse areas and on express or elevated or depressed roadways.
Medium pedestrian traffic—as on secondary business streets and some industrial streets.
Heavy pedestrian traffic—as on business streets.

TABLE II—CLASSIFICATION OF HIGHWAYS (ROADWAY TYPE) BY TRAFFIC DENSITIES
Maximum Vehicles per Hour, One Direction
(As recommended by the Illuminating Engineering Society)

	Undivided Highway		Dual Highway	
Number Lanes	Satisfactory Maximum	Tolerable Maximum	Satisfactory Maximum	Tolerable Maximum
2	500	1,000	.....	.....
3	1,350	1,500	.....	.....
4	1,350	2,000	1,350	2,600
5	1,600	2,750	.....	.....
6	1,600	2,900	1,600	3,200

TABLE III—RECOMMENDED AVERAGE HORIZONTAL FOOT-CANDLES (LUMENS PER SQUARE FOOT) FOR URBAN STREETS
(Illuminating Engineering Society)

	Vehicular Traffic Classification			
Pedestrian Traffic	Very Light (Under 150)	Light (150–500)	Medium (500–1,200)	Heavy to Heaviest (1,200 up)
Heavy	*	0.8	1.0	1.2
Medium	*	0.6	0.8	1.0
Light or none	0.2	0.4	0.6	0.8

* This condition is unusual, but if it should occur the foot-candle figures appearing in the column to the right may be used.

(a) The recommended foot-candle values are the minimum average values on the roadway between curbs. On streets carrying from light to heaviest traffic, the lowest foot-candle value at any point should not be less than one-fourth of the above values. On streets carrying very light vehicular traffic the ratio between average and the lowest foot-candles at any point may be of the order of ten and produce satisfactory results.

(b) In general there will be satisfactory illumination on the sidewalk by lighting system which provide the above recommended street illumination. However, visibility on the sidewalk should be given adequate consideration when selecting luminaires.

be used extensively for relatively high-level lighting, due to their distinctive and attractive blue-white color and the economics resulting from high efficiency of light generation and exceedingly long life. The sodium lamp, which generates about 2½ times as much light per watt as a filament lamp of comparable output, will continue to be used wherever its distinctive golden yellow color will identify a bridge, viaduct, intersection, underpass, grade crossing, or other danger point. It will also provide an abundance of well distributed light on through trafficways for adequate and attractive seeing conditions.

The fluorescent lamp, which has received widespread acceptance for interior lighting, does not lend itself to highway lighting in its present state of development. The outstanding handicaps to its use today are its sensitivity to ambient temperatures, the difficulties in controlling the light distribution of a source of this shape, and of housing and supporting it in an unobtrusive manner. The fluorescent lamp, while highly efficient, is not available in sufficiently large sizes for highway needs.

A comprehensive analysis of the fluorescent lamp in the field of street and highway lighting will be found in the report of the Committee on Street and Highway Lighting of the Illuminating Engineering Society, published in the February, 1946, issue of *Illuminating Engineering*. The committee concludes in this report that, "In these studies fluorescent street lighting, using lamps and luminaires available to date, was found to be at a considerable economic disadvantage in comparison with modern filament-lamp practices."

Lighting for freeways

Most freeways consist of two wide highways with a dividing strip between, and run from 75 to 100 ft. in total width. Mounting of luminaires along the outside edges is usually more desirable than on the dividing strip, since the distribution of light is more favorable to traffic safety. This means that large lighting units of 15,000 lumens are needed, with medium width asymmetric distribution and lateral width up to 45 deg. in the cone of maximum candlepower at approximately 75 deg. Such luminaires as the G-E Forms 81, 101 and 79 (Fig. 2) are being effectively used in this application. Further developments are anticipated as the use of freeways increases.

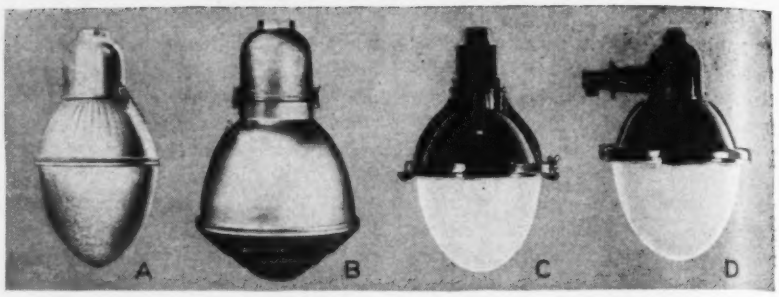


Fig. 2. Larger types of luminaires now are available for highway and street lighting. Shown here are: (A) the G-E Form 79; (B) Form 79VR, which is the largest; (C) Form 81; and (D) Form 101.

On heavy traffic arteries forming part of a highway system through urban areas, modern practice calls for pendent luminaires. These lumi-

TABLE IV—ESTIMATED INSTALLED COST OF LIGHTING PER MILE OF FREEWAY (FOUR LANES) AT 0.8 AVERAGE FOOTCANDLES
(Committee on Highway Lighting, Highway Research Board)

	Metal Poles, Underground Cable				Wood Poles, Overhead Wire			
Lamp and Luminaire Used								
Lamp type	Fil.	Fil.	Sod.	Mer.	Fil.	Fil.	Sod.	Mer.
Lamp lumens	10,000	15,000	10,000	16,000	10,000	15,000	10,000	16,000
Number of lamps	54	48	75	53	54	48	75	53
Luminaire beam	Medium	Wide	Wide	Wide	Medium	Wide	Wide	Wide
Equipment Cost								
Luminaires	$1,000	$1,650	$4,700	$960	$1,000	$1,650	$4,700	$960
Lamps	50	90	540	350	50	90	540	350
Poles and brackets	4,300	3,800	6,000	4,200	1,900	1,700	2,600	1,900
Insula. transformers	950	1,300	.....	1,000	950	1,300	.....	1,000
Cable and wire	1,000	1,000	1,100	1,000	400	400	400	400
Total equipment	$7,300	$7,800	$12,300	$7,500	$4,300	$5,100	$8,200	$4,600
Cost of Installing (1939 Prices)	$3,300	$3,000	$3,800	$3,300	$2,600	$2,600	$3,400	$2,600
Total Installed Cost Approximately	$10,600	$10,800	$16,100	$10,800	$6,900	$7,700	$11,600	$7,200

TABLE V—ESTIMATED ANNUAL OPERATING COST OF LIGHTING PER MILE OF FREEWAY (FOUR LANES) AT 0.8 AVERAGE FOOTCANDLES
(Committee on Highway Lighting, Highway Research Board)

Lamp Watts and Life								
Watts per lamp	485	715	225	440	485	715	225	440
Average service life, hours	1,600	1,600	2,000	5,000	1,600	1,600	2,000	5,000
Maintenance Costs								
Lamp renewals, washing, patrolling, globe replacements, and minor repairs	$350	$400	$1,500	$530	$350	$400	$1,500	$530
Energy Costs								
Watts per lamp plus 10 percent line lost x 4,000 hours per year								
@ 1¢. per kwh	$1,130	$1,540	$520	$1,010	$1,130	$1,540	$520	$1,010
@ 1½¢. per kwh	1,700	2,300	780	1,510	1,700	2,300	780	1,510
@ 2¢. per kwh	2,270	3,070	1,050	2,020	2,270	3,070	1,050	2,020
Approximate Total Annual Operating Cost								
@ 1¢. per kwh	$1,500	$1,950	$2,000	$1,550	$1,500	$1,950	$2,000	$1,550
@ 1½¢. per kwh	2,050	2,700	2,300	2,050	2,050	2,700	2,300	2,050
@ 2¢. per kwh	2,600	3,500	2,550	2,550	2,600	3,500	2,550	2,550

The sodium lamp in the above table is given a rating of 2,000 hours life. In actual service, these lamps are averaging 50 to 100 percent longer life than this rating.

naires have utilization efficiencies two to three times those of older types, and employ 10,000-lumen and 15,000-lumen lamps. Such units are normally used with internal deflectors to direct more light to the pavement.

Three new developments for residential street lighting will help to provide a transition in illumination values between well lighted highway entrances to cities and present poorly lighted residential through streets. The largest of these luminaires, the Form 79VR (Fig. 2), was developed shortly before the war. It provides the most effective lighting thus far devised for residential streets, and has already been installed on some Detroit streets with marked success. The reflector efficiently distributes the light from 4,000 or 6,000 lumen lamps over long spacings (usually 300 ft.) at low installation, maintenance and operational cost. The refractor bowl limits the amount of light delivered beyond the sidewalks. The large vertilateral refractor is available either with two-way or four-way light distribution—the latter for use at intersections.

The other two reflectors offer, for the first time, efficient light control and distribution from reflectors in the minimum price field for lamp bulbs of 2,500 lumens or less. Both reflectors also offer two to three times the seeing ability of the old radial-wave unit, which they were designed to replace. A new, small 2,500 lumen lamp, which allowed compactness in reflector size, was developed for these two units.

The open type suburban reflector costs about the same as the radial-wave reflector, and has a scientifically developed contour accurately formed in specially processed aluminum. The edge of the reflector shields the lamp filament from view at high angles and improves the effectiveness of lighting on the cross street when used at intersections. Attachable reflecting shields provide additional low-angle shading of house fronts and conservation of lamp light.

The enclosed reflector is spun-sealed to a small vertilateral refractor which provides advantageous accuracy of light control for maximum visibility effectiveness. The lamp filament is positioned high in the specular, highly finished reflector to provide low-angle shading for house fronts on both sides of the street.

Limitations of colored light

The choice of type of luminaire depends upon many factors other than the cost of installation and operation and the relative efficiencies of the light source. One important factor is the color of the light. Mercury and sodium may both be generally classified as monochromatic, the former a blue-green color and the latter a yellow color. Both, therefore, distort the normal appearance of colors and may be objectionable where there is pedestrian traffic except under extenuating circumstances. Mercury lighting, for example, is entirely acceptable in downtown business streets where signs, show windows, etc., contribute the necessary red and yellow light to provide a reasonably balanced spectrum. Sodium lighting used at hazardous intersections, underpasses, etc., displays the amber color commonly employed as a cautionary signal to motorists.

Both mercury and sodium are appropriate for highways as the level of illumination is of an order that precludes the need for considering the color of the light.

Highway lighting costs

The relative cost of the several systems of lighting appropriate for highway work will vary with the local circumstances. Hence, definite conclusions cannot be drawn from any specific set of figures. Nevertheless, the figures given in Table IV, which was prepared by the Committee on Highway Lighting of the Highway Research Board, are indicative of the relative cost of such lighting.

Operating costs for a mile of four-lane freeway lighting are given in Table V.

Fig. 3. Approaches to underpasses warrant higher levels of lighting. This approach on Western Avenue Boulevard, Chicago, has an average illumination on the pavement of 1.1 foot-candles. Refractor type pendent luminaires are used, with 6,000-lumen series lamps mounted 26 ft. above the pavement. Units are spaced 50 ft. apart, and staggered.

Virginia Expands Use of Asphalt To End Pumping At Joints in Rigid Pavements

***Contents in Brief**—Asphalt of 30 to 40 penetration is being used in Virginia to fill the voids below rigid highway pavements at the transverse joints and thereby end pumping at the joints. Best results are obtained at a typical joint if the asphalt is forced below the pavement through a single 1½-in. dia. hole drilled in each lane 18 in. from the joint in the direction of travel. A delivery temperature of 375 deg. F. is used. If the difference in elevation of the two slabs at uneven joints is not more than 1½ in., delivery of the asphalt is continued until the low slab is raised to correct position.*

THREE years of experimental work by the Virginia Department of Highways indicates that pumping at transverse joints and cracks in rigid pavements may be overcome at reasonable cost by filling the voids below the slab with liquid asphalt. The work also reveals that if one slab is not more than 1½ in. higher than the other at the joint the pavement's riding qualities may be improved appreciably by continuing pumping on the low side until the slabs are at the desired relative elevation and a smooth joint provided.

Virginia's experience in this experimental work closely parallels that of Texas, which was reported in *ENR* Sept. 19, vol. p. 370. Ohio has used asphalt to replace mud below pumping joints since 1942 (*ENR* Aug. 26, 1943, vol. p. 333).

In the fall of 1944 Virginia used 6,000 gal. of asphalt of 30 to 40 penetration to eliminate pumping at the joints of a short section of pavement on U. S. Route 1 near Richmond. The results were so promising that 40,000 gal. were used last year in a similar way and this year the plan is to use 60,000 gal. In 1947, if the supply of manpower and materials continues to improve, the work will be expanded still more, as the department now looks upon the use of asphalt in this manner as another worthwhile maintenance method.

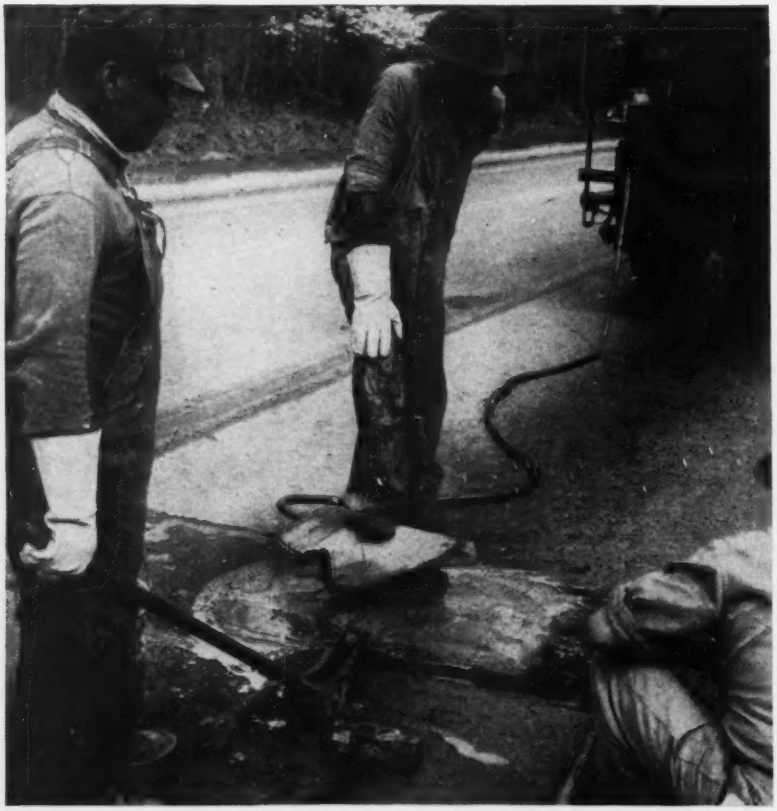


Fig. 1. Asphalt is added below the slab through a single hole in each lane at each joint, the hole being placed about 18 in. from the joint in the direction of travel.

How to get best results

Operations to date reveal that the best results are obtained when an asphalt of 30 to 40 penetration placed at a temperature of 375 deg. F. is used. Good results have been obtained in both cold and warm weather but it is considered most desirable to do the work on warm days—with the temperature above 70 deg. Under such conditions the pavement is expanded and better seals are provided by the filler material in the joints. This reduces the loss of asphalt upward through the joints or cracks and at the edges of the pavement. Moreover, on warmer days the possibility of clogging in the feed lines from the standard distributors of 500- and 1,000-gal. capacity used to deliver the asphalt is reduced.

General procedure of the Virginia crews is to work on one lane of the pavement at a time, leaving the other lane free for travel controlled by flagmen. At first, two holes were drilled for each lane at each joint. But as work advanced, one 1½-in. dia. hole in each lane was found sufficient. Normally this hole is placed in the middle of the lane 15 to 18 in. from

the joint in the direction of travel. However, where the slab has settled unevenly the hole is drilled nearer the edge of maximum settlement, or two holes may be drilled. The holes are made with pneumatic jackhammers supplied with air from a 125-cfm. portable compressor towed along as work advances.

Addition of the asphalt follows closely behind the drilling of the holes, as this procedure results in the least interference to traffic in treating a given section of pavement. Immediately before pumping at a hole is begun, the surrounding pavement is painted with a solution of 2 lb. of lime per 8 gal. of water to prevent spilled asphalt from sticking to the pavement.

A 2-in. flexible hose equipped with a tapered injector nozzle delivers the asphalt from the distributor to the hole. To avoid a loss of pressure at the hole and a leakage of the asphalt, a layer of burlap is wrapped around the nozzle which is then driven into place with a few blows from a sledge. A delivery rate of 125 to 150 gpm. is used and the delivery pressure at the nozzle is similar to that in "shooting" a tack coat in repair of blacktop pavements, or about 150 psi.

When to stop pumping

If the two slabs are level, delivery of asphalt at a given hole continues until the voids below the pavement at that point are filled but before the slab at either side starts to rise. This method reduces asphalt requirements and thus the cost per hole for materials. A crew soon becomes skilled in knowing how much asphalt to add.

Where one slab is lower than the other at a joint, the delivery of asphalt below the low slab continues until the two slabs are level, provided the difference in elevation is not more than 1½ in. If one slab is appreciably lower than the other at numerous joints, asphalt is not employed to level up the pavement, as this process is regarded as uneconomical because the asphalt would need to be added in several stages, rather than one continuous pumping and because large amounts of asphalt would be required. Instead, a slurry placed with mudjacking equipment is used to level up the slabs, the best slurry being considered that containing on a weight basis the following materials:

Fig. 2. A crowbar with a special head simplifies removal of the nozzle from hole once pumping ends.

Clay soil, 48.2 percent; lime, 16.1; portland cement, 6.0; RC-1 bituminous material, 9.6; and water, 20.1.

The method used to determine when the two slabs at a joint or crack are level when adding asphalt below the pavement is illustrated by Fig. 3. Frequently, the asphalt will appear at the edge of the pavement or be forced upward through the joint or crack where work is under way before the low pavement has been raised the desired amount. When this occurs pumping of the asphalt is stopped, and if only a little additional jacking is desired at that point the crew generally advances to the next joint without planning further pumping at the first location. However, in some cases after a few days or when the asphalt has solidified and sealed the passageways by which the asphalt was escaping the crew will return to the joint to add more asphalt at that point. A second pumping usually suffices for a hole, but on rare occasions three pumpings are used.

Asphalt requirements vary

The amount of asphalt required at a delivery hole in the pavement varies greatly. At some openings only a few gallons are used. At one particular hole, 150 gal. were needed, delivery stopping when the asphalt appeared at the edge of the slab some 75 ft. from the joint. The average requirement to date has been about 15 gal. for each hole or about 30 gal. for a joint the full width of a 24-ft. pavement.

Once delivery of asphalt is ended at a hole the nozzle is quickly removed and a wooden plug driven into the opening. This plug, which is left sticking above the pavement about an inch, prevents the loss of asphalt. Later—or as soon as the asphalt has started to solidify—the plug is removed and the hole filled with a mixture of sand and asphalt.

The usual crew employed consists of a distributor operator, a driver for the service truck required to trans-

Fig. 3. A 1 x 4-in. board about 7 ft. long held transverse to the joint is used to determine when the low slab has been raised sufficiently.

port the necessary warning signals and other supplies, two men using the delivery hose and painting the pavement with the lime solution, two common laborers drilling the holes, and a foreman. With such a crew as many as 150 holes have been drilled and pumped in one 8½-hr. day, but the average is about 125 holes in a normal day.

The cost for materials and labor averages $2.31 for the 303 holes drilled and pumped in 1944. The increased cost of materials since 1944 has been offset by greater efficiency of the crews, and on the work now under way the cost is expected to be about the same. A major factor in keeping costs low has been the use of sufficient crews to permit the railroad car delivering the asphalt to be unloaded in a few days, thereby reducing both heating costs and demurrage charges.

Because of the beneficial results obtained to date, the expenditure listed is considered highly justified. Practically no pumping has occurred at the joints treated, although traffic is extremely heavy on the pavements repaired and includes a high percentage of heavily loaded trucks. Moreover, no highway districts have reported the need to go back and "repump" any of the sections of highway thus repaired.

The work described was carried out under the general direction of J. J. Forrer, maintenance engineer of the department. C. S. Mullen is chief engineer of the Virginia highway organization.

Streets Cleaned by Pressure Flushing

STREET CLEANING by pressure flushing instead of sprinkling or using a mechanical broom is practiced in Seattle, Wash., through a combination of good equipment and favorable conditions.

Seattle, located in the so-called "Evergreen Playground" of the Pacific Northwest, has plenty of water available by gravity flow which city maintenance men make good use of in the flushing operations. Weather conditions are also favorable, as Seattle has very little freezing weather and rarely has snow. Most of Seattle is built on hills, so the streets are usually on a grade. However, there are areas along the waterfront that are relatively flat, and there the use of a mechanical broom is required.

Flushing equipment was designed under the premise that volume with pressure moves dirt. The truck shown on the left in the accompanying illustration is equipped with four flushing nozzles, mounted two on the front and one at each side. The tank has a capacity of 1,500 gal. and the water pump has a capacity of 625 gal. per min. and is capable of maintaining a continuous water pressure of 50 pounds per sq. in. with three flusher nozzles operating.

Flusher unit improvements

Improvements over a 20-yr. period in design of vehicles for mounting street-flushing equipment are readily apparent. However, increased vehicle speed is the only factor with any appreciable effect on street cleaning operations, as the flushing equipment on the two vehicles is similar. The tank capacity of the older unit is 1,200 gal., and the two trucks have nozzles mounted in corresponding locations and pumps of substantially the same capacity. The newer unit is capable of developing speeds up to 60 mph., whereas the older unit has a top speed of some 20 mph. This greater flexibility of speed considerably increases the amount of territory which a flushing unit can cover in a given period.

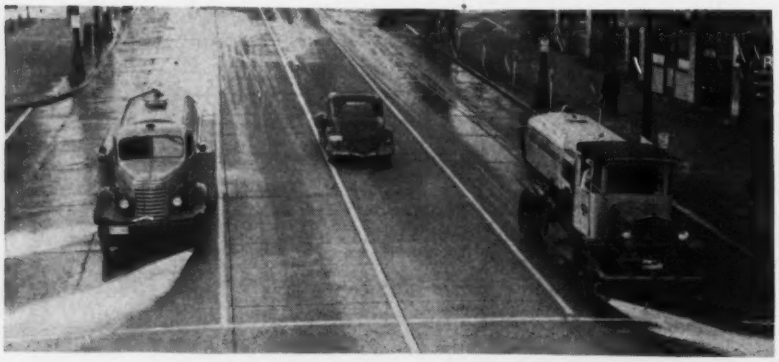
In new equipment the pump and pump motor are enclosed at the rear of the streamlined body. Thus they are protected and yet in a position easily accessible for maintenance or repairs when the equipment is in the shop.

Seattle's flushers start work early in the morning in the downtown areas while pedestrian traffic is light. Later in the day they move out to arterial streets and residential districts. The trucks can be refilled with water by the pressure from any convenient hydrant.

Curb design affected

Seattle's flushing operations have affected the design of curbs and sidewalks in the city. It was found that a rolled curb would not do as the water climbs over and spreads debris on the sidewalk. Sidewalks are built with a 2½ percent slope away from the buildings toward the curb to carry away such water as does get on them. The nozzles on the flusher units, or shoes as they are called in Seattle, have been developed over a period of many years by city personnel. They are designed so as to give a volume of water with sufficient pressure to sluice the street debris along the gutter lines. The shoe design is markedly different from the ones with which standard equipment comes equipped. The shoes delivered by the manufacturers are designed for a spraying operation, rather than actually moving debris by water volume.

Seattle's street cleaning work is under the direction of C. L. Wartelle, city engineer, and J. Robertson, Jr., maintenance engineer.



Two of Seattle's fleet of flushers team up to work on a downtown street. The truck on the right is a veteran of almost 20 years service and the one on the left is a recent acquisition. The trucks mount similar flushing equipment.

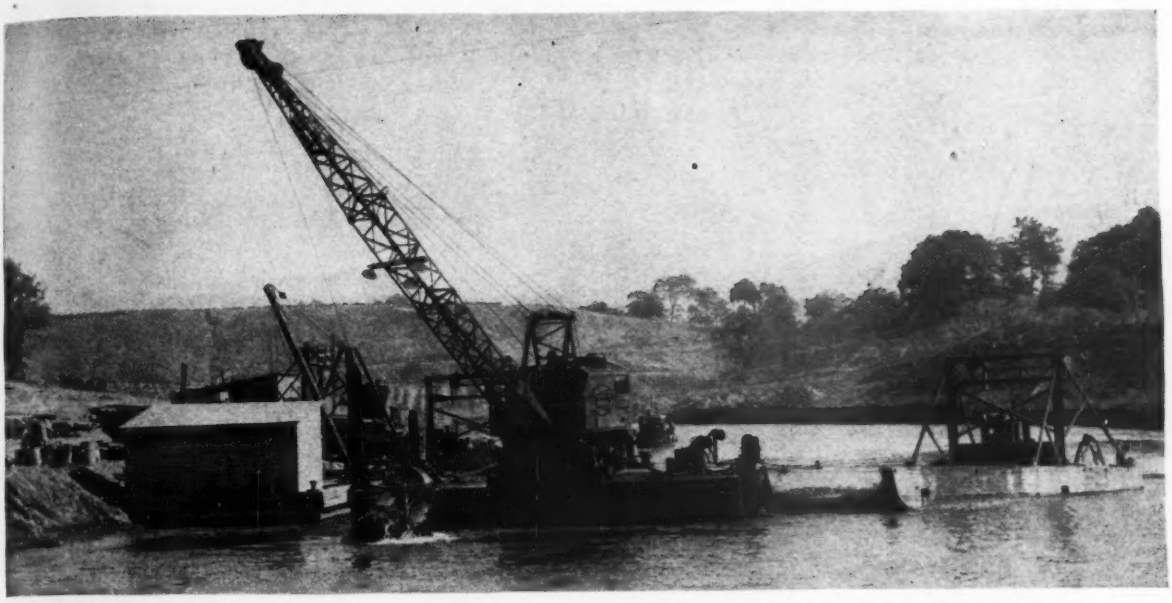


Fig. 1. Barge-mounted dragline digs 60 cu. yd. of muck per hour. The muck is hauled away by a landing lighter.

Moving Sticky Mud with Drag Equipment

***Contents in Brief**—An unusual arrangement of drag scraper, dragline and war surplus cargo lighters is being used to remove 900,000 cu. yd. of material from an operating tail race below the DeCew Falls powerhouse in the Niagara area. Cranes, mounted on scows equipped with special spuds, use dragline buckets to dig sticky mud and dump it on shore for moving back by drag scraper. In another operation the cranes load on self-powered lighters for transport to a disposal area where muck is taken off by a drag scraper that gets its power from a floating rig.*

USING METHODS that are definitely unorthodox, C. A. Pitts General Contractor Ltd. is economically moving a lot of sticky mud from three miles of tailrace below the DeCew Falls plant of the Hydro-Electric Power Commission of Ontario. Enlargement of the channel is being undertaken as part of the complete replacement of the old plant at DeCew Falls (*ENR* Nov. 4, 1943, vol. p. 661 and Oct. 11, 1945, vol. p. 475).

The existing 3-mile long tailrace is shallow and winding. Its current is swift as the present 1,400-sq. ft. cross-section carries 4,500 cfs. Also, five dumped-stone weirs across the channel produced a head loss of about 13 ft., which is to be made available at the plant in the present work of deepening and enlarging the tailrace to carry 5,000 cfs. without excessive head loss.

This channel is cut through cohesive material that cannot readily be handled by suction dredges and there is no way of entry for a dipper dredge.

Along the existing channel there are some high banks where disposal is not practicable. There are other areas where it is expected that any superimposed load might cause slides and sluffing of the bank that would reduce or close the waterway. Hence, only selected areas are available for disposal, requiring in some cases that material be moved well back from the waterfront and piled quite high. Access to the river bank is limited and dumping of sticky mud in deep spoil banks would be difficult.

Contractors were asked to submit with their bids plans for accomplishing the channel enlargement. The Pitts organization based its bid on use of conventional dragline equipped cranes operating on land where possible, or on steel barges, which would pass material to ordinary drag-scraper equipment for disposal.

Three separate units for excavating and disposing of muck were planned and are now in use by the contractor. It is the supplemental equipment and devices used to adapt the conventional machines to the unusual project that are of particular interest.

Excavation in the channel

About half of the 900,000 cu.yd. of material to be excavated has to be loaded and transported for some distance along the stream to a convenient disposal area. The method used here is to dig with a dragline bucket on a crane mounted on a barge and to load the material on scows for transportation to a disposal area where it must be moved back, in some

Fig. 2. Self-powered landing lighter takes dredged material to convenient disposal area where it is unloaded by drag scraper. The hoist unit for the drag scraper moves with it on a similar self-powered lighter.

cases several hundred feet, from the channel. The crane used for digging is a 2½-cu-yd. unit with 90-ft. boom and fairlead for dragline work. The crane is bolted down to the stern of a 40x60x7-ft. barge that has four conventional vertical spuds that are lifted or pressed down by use of 20,000-lb. capacity hand winches.

Special spuds resist bucket pull

Digging with a heavy pull on the dragline could be expected to be very hard on the vertical spuds on the barge and these were supplemented by diagonal spuds set against the pull of the loading of the bucket. The diagonal spuds, Fig. 3, are hinged in a ball and socket joint at the vertical spud wells and are held by a brace, with two universal joints, attached to the stern.

In operation, after the dredging unit has been moved to position to dig, the drag bucket is dropped to the bottom to get a firm hold in the mud. The inclined spuds are lowered to position and a pull taken against the bucket so the scow moves toward the bucket embedding the spuds. The vertical spuds are dropped and their holding cables tightened.

In starting a move, which is always downstream in the swift water of the tailrace, the drag bucket is again used to pull the barge slightly upstream and release the strain so the vertical spuds can be lifted, after which the inhaul line is allowed to run out so that the barge drifts downstream. The diagonal spuds pull out without attention and again embed themselves when a strain is taken on the dragline.

It was planned to use 125 to 150-cu.yd. capacity scows and a small tug boat for hauling excavated material along the river, but floating equipment of any type was difficult to get. Subsequently, arrangements were made to purchase moderate-size timber scows in knock-down condition from war surplus material held by the government, but these could not be released in time to start the job.

Cargo lighters haul muck

As an expedient, several 18.5x52x3-ft. self-powered war surplus 35-ton capacity cargo lighters with 14.5x40 x3-ft. cargo boxes were obtained. These were made largely of 1-in. plywood and powered with two 100-hp. motors. They were planned for one invasion trip across the English Channel. Each motor operates a separate propeller and the vessels have good rudders so are readily maneuverable in the swift current.

The units purchased had not been used but came to the job completely prefabricated and packaged for overseas shipment. They were assembled on shore where a frame was built near the stern to hold a sheave for the backhaul line on the drag bucket planned for unloading them, Fig. 2. One of the lighters was taken for use as a movable base for the unloading operation, mounting the two-drum hoist required for drag scraper work. Vertical spuds were added to this vessel to assure rigid anchoring and a frame across the front holds fairleads, one of which guides the

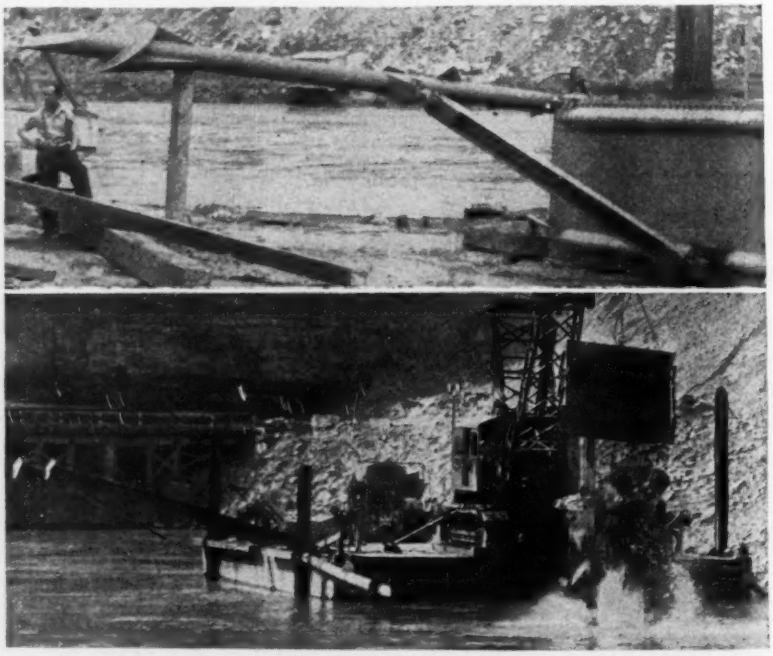


Fig. 3. Special spuds are keys to successful dragline operation from barges. Above, a diagonal spud, which works in ball-and-socket joint, is held by a double-hinged strut. Below, diagonal and bank spuds are in raised position while rig is dumping riprap.

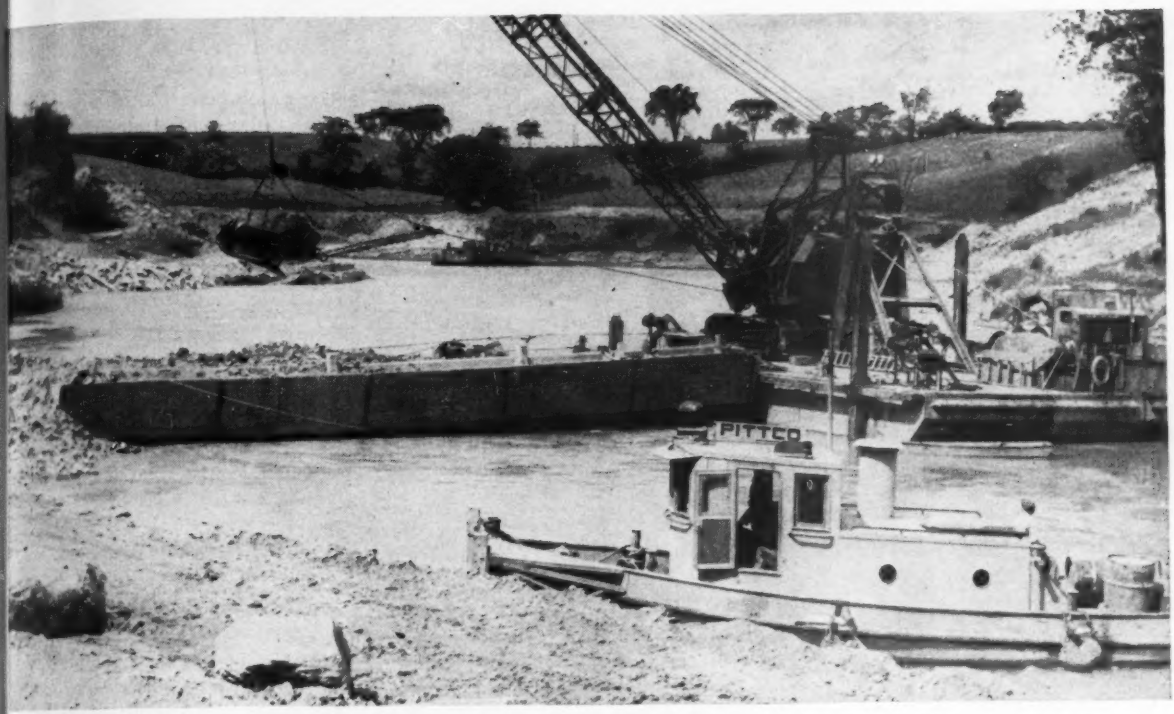


Fig. 4. A causeway made up of five 12x22.5ft. scows serves as a fender and dump area. Muck is dragged off the scows and 1,000 ft. back by a dragscaper hoist mounted on the bow of the crane barge.

backhaul line to the muck lighter brought alongside.

Another of the self-powered cargo lighters has been rigged as a general job tender with a hand-operated derrick for delivering fuel drums, changing buckets and the like. The lighters were expected to be too small and not sturdy enough for the work and have proved to be smaller than economical but reasonably strong. They will carry only 20 cu.yd. of wet muck and must be loaded rather carefully but, with steel lining of the cargo boxes, have served fairly well. One unit loading, one unloading and one moving, with provision for tying up on either side of the loading or unloading unit, permits excavation of about 600 cu.yd. per 10-hour shift.

The muck lighters will be replaced, as they wear out, with larger units that are not self-powered and which will be handled by a 35-ft. 150-hp. diesel tug. The lighter used as a floating base for the drag scraper and the derrick-equipped tender are expected to serve until completion on the job.

Much of the material to be moved can be excavated by a crane with dragline bucket operating from a barge close enough to the bank to cast on shore where the muck can be dragged back by a scraper. A steel barge similar to that used for work away from the shore is rigged with the same type of spuds and carries a 2½-cu.yd. capacity dragline.

The hoist for the drag scraper is mounted on the forward end of the barge and only an outhaul anchor for the drag cable, plus the drag bucket, is needed ashore. To counteract the pull of the drag cable "bank spuds" are mounted on the shore side of the rig. In operation, the spuds resisting the digging pull are set first, the barge is pulled in against the bank spuds and then the vertical spuds are dropped.

Experience in digging with this

Fig. 5. The tractor at the right serves as an outhaul anchor for the drag scraper and has the power to move itself when required.

Fig. 6. Land-based crane dumps material where drag scraper can haul it back to desired disposal area. Truck haul was not found practicable.

rig indicated further efficiency and another use of available war surplus equipment if the scow could be held out further from the bank and still cast muck where it could be dragged directly ashore. These conditions were met by making a "floating causeway" of five 12-ft. long sections of 22½-ft. wide 5-ft. deep timber scows, Fig. 4, purchased from the Canadian War Assets Corp. The scows have 2.5-ft. high side combings above the deck at the 5-ft. line but ends are open so that muck dumped on the deck can be pulled ashore by the drag scraper arrangement described above. The causeway holds the crane scow 60 ft. offshore permitting digging and disposal for almost the full width of the tail race.

Digging in the tough muck is increasingly difficult as depth becomes greater due to the angle of the drag cable. To overcome this, the channel is being deepened in stages and the control weirs downstream progressively removed to lower the water and permit a more direct pull on the digging bucket.

Land-based unit

The third major method used for excavation is to work along the shore with a land-based crane using a 2-cu.yd. dragline bucket to cast the material landward, where it can be dragged back by a scraper. Truck or wheeled-scraper haul from this rig has not been found practicable. There is only a small part of the work that can be done by this means, however.

The drag scraper equipment is readily movable. The hoist is mounted on skids and a pipe headframe hinged to the rig so that it can be moved ahead as a unit by the tractor assigned to the operation for building dikes, clearing and the like. A light structural frame serves as a tail tower and is moved by an obsolete tractor that then is run up on the back of the tower to serve as a counterweight.

Speed and costs compared

Different earth conditions, shifting the equipment, interruption for other work and similar factors have prevented a real comparison of the three methods of moving sticky mud. About 80 cu.yd. per hour is being moved by the land-based unit and by the marine unit dumping on the bank or causeway for direct disposal by drag scraper. The outfit dumping on the small scows for disposal handles about 60 cu.yd. per hour.

Bid price for excavating the muck is $1.23 per cu.yd. Actual cost of the work to the contractor has not been divulged but is said to be considerably below the amount estimated in bidding. Unit costs of the three methods, however, are in the ratio of 1:1:1.25 for the land-based, along the bank, and scow-disposal units respectively.

Excavation of this 900,000 cu. yd. of material is a major item of work required in connection with the installation of the second 70,000 hp. unit at the DeCew plant. Design of the improvement is under the direction of O. Holden, hydraulic engineer of the Hydro-Electric Commission of Ontario for which A. L. Malcolm is district engineer and W. S. Campbell is resident engineer on construction.

For C. A. Pitts General Contractor Ltd., C. A. Pitts is in direct charge. N. S. Bateman is chief engineer, E. A. Missiaen is superintendent and M. F. Missiaen is equipment manager.

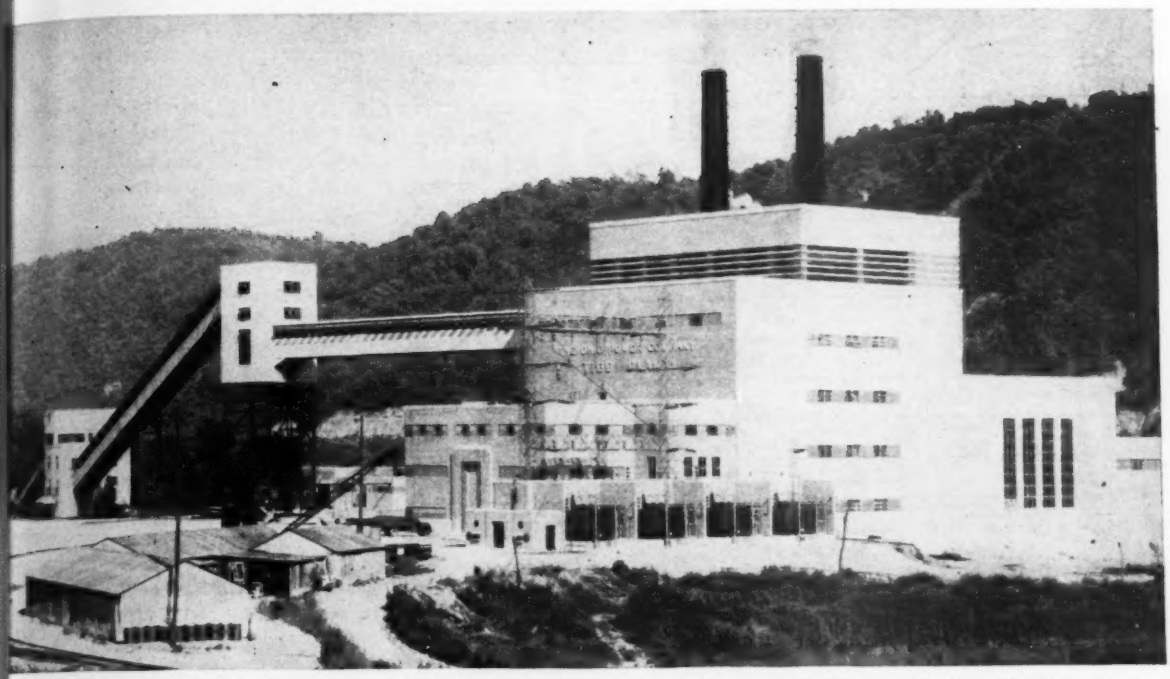


Fig. 1. Modern architecture, efficient layout, clean operation and protection from floods were design objectives for new Tidd steam electric plant of The Ohio Power Co. Walls are of composite masonry above maximum high water.

Modern Steam Electric Power Station Built on Riverside Site

H. A. Kammer
Construction Engineer
American Gas & Electric Service Corp.
New York, N. Y.

***Contents in Brief**—For the new Tidd plant of The Ohio Power Co. careful site studies resulted in placing part of the structure on piles, while the part nearest the river is supported on a slab bearing on firm sand and gravel 25 ft. below normal pool level of the Ohio River, and nearly 75 ft. below flood stage. Concrete walls are used below flood level and composite masonry walls above. Frame of power plant is structural steel. Special provisions are made to trap and dispose of dust and fly ash, so as to reduce maintenance costs.*

On a typical Ohio River flood plain about 10 miles downstream from Steubenville, The Ohio Power Co. has recently completed a new steam electric power plant whose structures and facilities reflect the experience acquired in designing and supervising the construction of more than 1,000,000 kw. of power plant capacity during the last ten years for subsidiary companies of the American Gas & Electric Co. This experience has demonstrated the necessity in the planning stage of close coordination of mechanical, electrical and civil engineering elements before any final solution is agreed upon. And it has further shown the need for careful site exploration, both in the interest of foundation design and of satisfactory and economical arrangement of structures and machinery. This latest plant has benefited to the full from this method of approach.

Known as the Tidd plant, it will have an ultimate capacity of between 500,000 and 600,000 kw., of which 100,000 kw. is included in the initial installation. Major facilities comprise a straight condensing turbo-generator unit, two pulverized-fuel boilers each producing 475,000 lb. of steam per hour at 1,450 psi. pressure, extensive coal handling equipment and switchyard gear to deliver the electrical output of the plant to the 132 and 66 kv. transmission systems. The power plant building itself is partly on piles and partly on thick load-distributing slabs, which also provide resistance to uplift during flood periods. The frame is structural steel, while the walls are concrete to

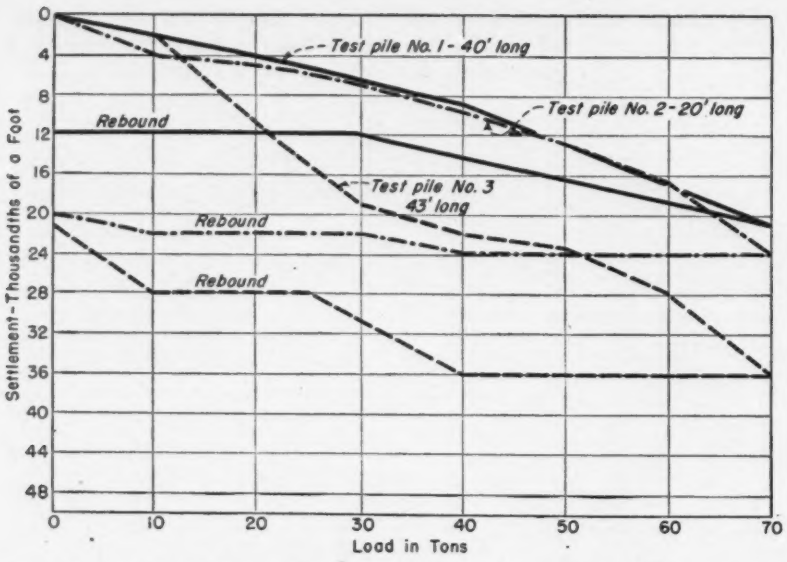


Fig. 2. Results of static load tests on step-tapered concrete piles indicated that the assumed design load of 50 tons was satisfactory and safe. All piles were driven into a firm sand and gravel stratum.

above maximum high water and of composite masonry construction elsewhere.

Foundation studies and design

Borings made at the site showed that the soil conditions above bed rock were very spotty and that pockets and strata of soft materials of different thicknesses and varying compressibility lay at different depths throughout the working area. This indicated that pile foundations would provide the most economical support for the boiler room, heater bay, shop, office, storeroom and water treating sections of the plant where deep excavation was not required.

Before work was started, the possibility of constructing the deeper foundations in an open excavation using only well points for controlling the groundwater was considered. This method had been used at a considerable saving at another station of The Ohio Power Co., where the foundation slab of the turbine room basement was founded 14 ft. below the normal groundwater level.

In order to determine whether the work could be carried on in an open excavation, an 8-in. well was driven, well points were installed around the well in order to measure the groundwater elevations and pumping tests were carried on for several weeks. These tests showed that fluctuations in the river level were reflected in the observation wells with a time lag of only a few hours. From the data obtained during these tests, the coefficient of permeability was computed as ranging from 0.095 to 0.21 cm. per sec., which is close to the upper limit for economical lowering of the groundwater level by pumping without a cutoff, under the conditions controlling the installation of foundations for this plant.

It was estimated that for a river stage of 32.0 ft., approximately 20,000 gpm. would have to be pumped. Since this elevation has frequently been exceeded by the river during the past twenty years the idea to make the deep excavations without a steel pile cutoff was abandoned and all of the deep concrete structures were constructed within a steel sheetpile cofferdam. Even though this cofferdam was driven to rock, it was necessary to handle about 8,000 gpm. to keep the excavation dry enough to permit the placing of concrete.

Based on the indications from the borings that piling would be required, when excavation to firm strata was not necessary, comparative designs and estimates were prepared for treated wood piles loaded at 30 tons each and step-tapered concrete piles loaded at 50 tons each. About 80 percent of the total load on each pile is dead load, the balance live load. The borings indicated that the piles should be driven about 5 ft. into sand and gravel strata overlaying bed rock, establishing the pile lengths at 15 to 40 ft. The estimates disclosed that in this particular case the most economical foundation would be provided by the step-tapered concrete piles, and this method of support was adopted.

Soon after the pile driving operations were started, three piles at diverse locations were load-tested, and the results given in Fig. 2 indicated that no revision was necessary in the assumed design load of 50 tons per pile. All of the piles were driven to a resistance of at least 36 blows for the last 6 in. with a single-acting steam hammer having a 5,000-lb. ram and a 36-in. stroke. These piles, located under the boiler room, coal bunker, machine shop and office areas, were topped with a thick mass concrete slab (top at El. 650), designed to provide resistance to uplift during floods.

Heavy slabs in condenser pit

The elevation of the steam condenser with reference to river level and the best arrangement of its associated equipment required the location of the bottom slab of the condenser pit 26 ft. below the bottom slab of the balance of the power house as shown in Fig. 3. Low water in the river determined the elevation of the bottom of the condenser pit, screen house and circulating water tunnels, turbine and boiler room main floor elevations. The yard grades adjacent to the power house were determined by the estimated flood elevations.

The pumping tests had indicated that a steel sheetpile cofferdam driven to rock would have to be constructed in order to place the concrete for the substructure of the condenser pit and screen house. In view of the fact that the foundation slabs would bear on firm strata of sand and gravel, similar to that in which most of the piles supporting the rest of the power house were driven, and because the steel cofferdam was to be left in place, it was decided that bearing piles would not be used for the support of turbine room basement, circulating water tunnels or screen house. The foundation mat for the turbine room area was designed on the basis of a soil bearing

capacity of 5,000 lb. per sq. ft.

The steel sheetpiling for the cofferdam was so located that it served as the outside form for the substructure concrete walls with a considerable saving in construction time and cost. These walls were constructed to provide flood protection to El. 680 and, to prevent random cracking on the outside, control joints were located at 15 to 20 ft. centers. Made by the use of tapered separation strips in the forms, the joints were ¼ in. wide at the exposed face and 1¼ in. deep. Filled with non-staining concrete-colored calking compound, these joints acted as expected, although there were a few cases where cracks developed between them even though shrinkage reinforcing in the amount of 1 percent was used in each face of the wall.

The design of the foundation for the 100,000 kv. turbo-generator unit was, in general, based on the recommendations of the General Electric Co. (See *ENR* Sept. 5, 1946 vol. p. 316). Foundations for other rotating equipment, such as fans, etc. were provided for on an empirical basis, the concrete mass being taken as five times the weight of the revolving part and with the immediate supporting beams haunched. Steel beams supporting rotating equipment were designed to carry the weight of the equipment and foundation, limiting the unit stresses to ⅓ of those normally used.

About 25,000 cu. yd. of concrete was placed in the power house and appurtenant structures. Ohio River sand and gravel were used as an aggregate, and an average of 4.8 sacks of cement were employed per cu. yd. of concrete. The water-cement ratio on a weight basis varied between 0.50 and 0.57.

As was to be expected, the river sand proved to be so deficient in minus 100 material that it was not possible to hold the cement as low as desired and still make a workable mix. To overcome this deficiency in the sand, rock fines to the extent of 7 percent by weight were added at the mixer.

The coarse aggregate was combined at the job using 50 percent No. 4 to ¾ in. and 50 percent ¾ in. to 1½ in. The use of the rock fines made it possible to hold the cement content down, resulting in a reduction in the cost, and, it is believed, a more durable concrete. The average 28-day compressive strength of the concrete was 4000 psi.

Power house forms and walls

The superstructure of the power house was constructed with composite masonry curtain walls supported by a riveted structural steel frame, 1.34 lb. of steel being required per cu. ft., which compares with a recently published report of the design of a similar structure utilizing 1.60 lb.

The steel was designed on the basis of the unit stresses specified in the War Production Board National Emergency Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings. The live loads in pounds per square foot were as follows:

Turbine room—main floor	500
Boiler room—main floor	300
Roofs (except in bunker bay)	40
Fan floor	175
Scale floor	150
Floors in general	100
Platforms	100
Heater bay floor—El. 707	300
Heater bay floor—El. 747	250
Heater bay floor—El. 776	200

The composite masonry walls were

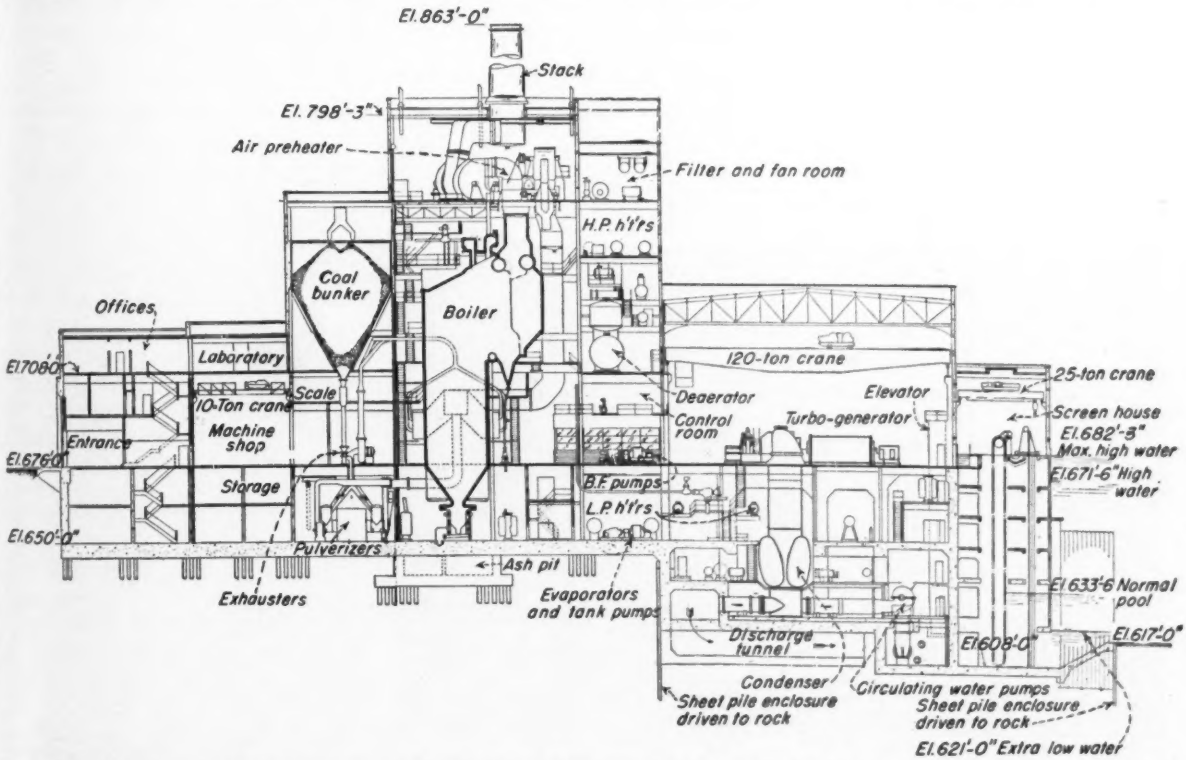


Fig. 3. Longitudinal section through power plant distinguishes between areas carried by piles and those supported directly on the sand and gravel, shows the disposition of the various facilities and the use of concrete walls below flood level.

laid up in a full bed of mortar with an ironspot brick on the outside face and a glazed brick tile on the interior. All joints were completely filled with mortar. Flashing and spandrel waterproofing were carefully provided in the design of the structure, and adequate inspection was maintained to assure good workmanship throughout. Experience of this organization has been that this type of wall compares favorably in first cost with a solid brick masonry wall having the inside face painted and, in addition, greatly reduces the cost of maintenance.

Interior partition walls below the 650 ft. floor elevation were constructed of cement block with very satisfactory results from both the standpoint of appearance and cost. Above El. 650 glazed tile was used for all interior partitions except in the office section where some metal partitions and some structural tile and plaster partitions were installed. Aluminum window sash was used throughout the power house. Its initial cost compared very favorably with the cost of steel sash, and experience at other plants shows that the aluminum is more economical to maintain in satisfactory condition.

Reducing dirt and dust

The arrangement of the interior walls and the layout of the ventilation system were carefully studied in order to eliminate as much as possible the circulation of coal dust and fly ash throughout the plant. These affect, to an appreciable extent, the costs of janitor service, painting of pipe lines and equipment and the maintenance of control devices, failure of which might cause plant outages or in some cases serious damage to the major operating equipment.

As shown in Fig. 3, the area where the pulverizers are located at El. 650 was isolated from the balance of the building by partition walls. The tops of the bunkers are also sealed by a floor at El. 751 except for the openings through which the conveyor tripper feeds coal into the bunker. These openings are sealed by a strip of belting which is automatically lifted by the tripper for the width of the discharge chutes whenever the tripper travels back and forth to fill the bunkers. All joints of the bunker plates are riveted and seal welded.

Each boiler is provided with a water-filled and sealed pit where the fly ash and cinders are collected. Hydraulic sluices are installed in the boiler room basement floor to convey the cinders to a centrally located ash pit from where the cinders are pumped to the plant yard and used to build up the low areas.

Flood protection

The normal pool level of the Ohio River at the plant is at El. 633.5, U.S.G.S. datum, and the greatest flood of record attained El. 671.5 ft. in 1936. Available records of past floods over a considerable period of time indicate that once the river control works, located on the tributaries of the Ohio River upstream from the plant, are in operation, the maximum probable (150 yr.) flood at the plant will reach about El. 680, and accordingly, bulkheads, stop logs, etc. have been provided to keep the plant structures dry if the river should ever reach this height. Above this elevation it will no longer be possible to reclaim coal from storage.

Arrangements have been made to accept delivery of coal from trucks or railroad cars. In order to supply the plant with coal from storage when the Ohio River is at flood stage, which will inundate the railroad right of way and the highways, a reclaiming hopper has been constructed over the inclined belt conveyor which transports the coal from the car dumper pit to the crusher house and the plant. This hopper has been located at an elevation that will permit supplying the plant with coal from storage even though a flood stage 5 ft. in excess of the greatest flood of record is attained.

Experience at other plants on the system has shown that there has been a considerable loss of coal from yard storage when the storage pile is flooded or subject to erosion by flood waters. The natural ground elevation of the storage site has been inundated on an average of once every two years during the period that records of flood elevations are available. In order to eliminate the monetary loss incurred whenever an appreciable amount of coal is washed out of the storage pile, earth dikes were constructed around the coal storage area. Besides protecting the storage pile from erosion, these dikes also serve as the support for the railroad tracks over which the rail coal deliveries are handled.

The design of the entire project was handled under the general supervision of Philip Sporn, executive vice president and chief engineer of the American Gas and Electric Service Corp. The plant is named for George N. Tidd, president of the company, and a pioneer in the electric power industry.

The building structures were constructed by the Sollitt Construction Co. Inc., South Bend, Ind.

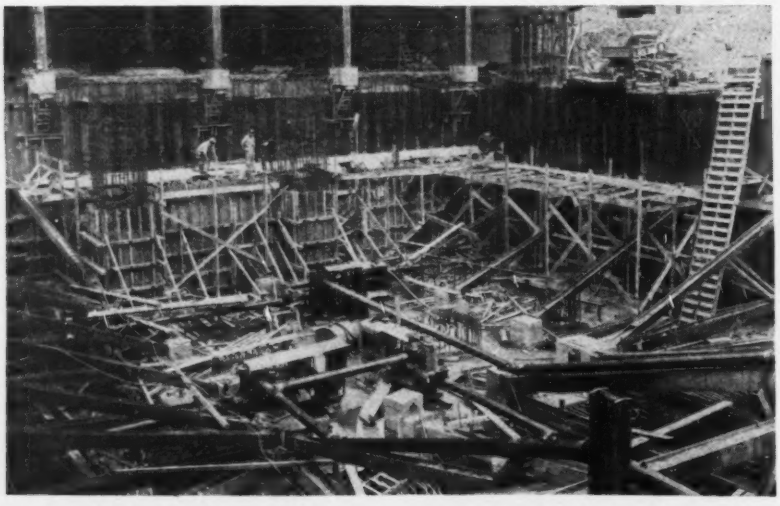


Fig. 4. Construction in the condenser pit, with assembly of forms for the discharge tunnel underway. The wellpoint pumps had to discharge about 8,000 gpm. to keep the excavation dry until the floor and walls could be completed.

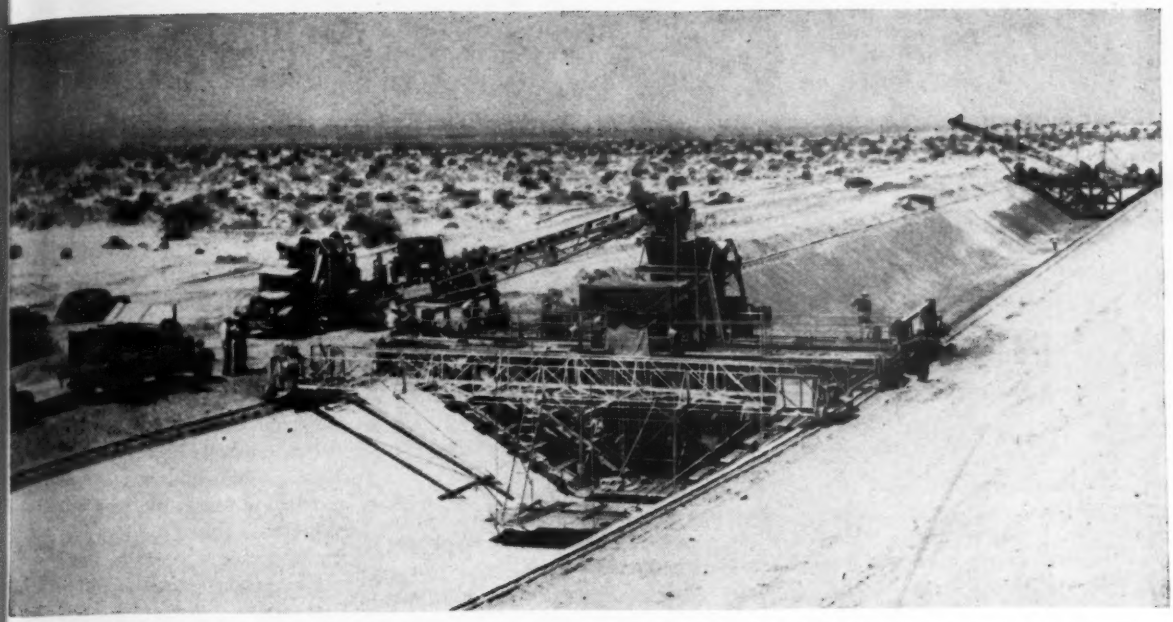


Fig. 1. Canal lining is being placed by the paver in the foreground. Beyond is the trimmer, fine-grading the canal.

Improved Trimming and Paving Equipment Used on the Coachella Canal

C. S. Hale
Construction Engineer, U. S. Bureau of Reclamation
Coachella, Calif.

***Contents in Brief**—Improvements on earlier types of trimmers and liners include, on the trimmer, a belt conveyor arranged to deliver on one side only, and on the paving machine, heavier steel finishing plates to prevent bulging, pipe templates to insure centering reinforcing mesh and concrete finishing platforms mounted on the paving machine itself.*

THE COACHELLA main canal, which branches off from the All-American Canal 20 miles from Yuma, will have a total length of 145 miles and will bring Colorado River water to some 75,000 acres of land in California's Coachella Valley north of the Salton Sea. The lower 55-mile reach is a concrete-lined canal with bottom widths ranging from 12 ft. down to 6 ft. and with side slopes of 1½:1. Designed for an initial capacity of 1,300 sec.-ft., the canal is being lined with a 3½-in. thickness of concrete reinforced with wire mesh very carefully placed in the slab.

The fine grading of the canal section and also the placing of the concrete lining are being done by large self-propelled machines of a type that has been highly successful in similar large canals. Early forms of trimmer and paving machine, designed by Clyde W. Wood, Los Angeles, were used in construction of canals on the Colorado River aqueduct some 10 years ago (*ENR* Feb. 20, 1936, vol. p. 279). Similar machines were used on the Gila project canals. The design of the equipment here described, based largely on these precedents, was revised under the direction of Mr. Wood, who added a number of features that represent improvements on and later developments of the earlier models.

The canal is roughly shaped by the excavating and filling equipment ordinarily used for such work, that is, carrying scrapers, bottom-dump trucks and bulldozers. No fine grading is attempted with this equipment but rather the canal prism is underexcavated in cuts and over-filled on compacted banks so as to leave sufficient trimming section for the machine that is specially constructed to do a very accurate job in final preparation of the subgrade both on the bottom and the sides. By following this procedure there is more assurance of the required compaction, particularly on the side slopes where a sheep's-foot roller cannot be used close to the edge.

The trimmer is of the bucket excavator type. There are two conveyor bucket systems, one on each side, which excavate the canal prism to the lines of the canal subgrade. These conveyors discharge on a system of

Fig. 2. Steel reinforcing mesh is kept at its proper depth in the slab by two pipe guides or templates. The 4-in. pipe (A) above the mesh is fastened to the frame of the paving machine and a 2½-in. pipe (B), shaped like a template to fit the canal section, passes under the mesh and holds it off the subgrade.

belts whose purpose is the deposition of excavated material in a spoil bank on one side only. This type of trimmer was a necessity on this job because of the plan to put a protective dike 25 ft. high adjacent to and along one side of the canal to prevent storm water from flooding into the canal and bringing debris with it.

This type of trimmer is well suited to work in material free from boulders, shale or sandstone. The first part of the canal traversed a sandstone and shale formation which put heavy strains on the excavating machinery and caused considerable mechanical failure with resultant delays. This experience brought about some improvements in the field. One of these was changing from a single wheel support at each post to twin-wheel supports.

The trimmer is electrically operated throughout, the current being supplied by a diesel-electric generating outfit. The rate of advance along the canal can be accurately controlled by a gear train from the driving motor. Hydraulic jacks are provided at each supporting post which enable the operator to adjust the machine for depth of cut. An outstanding difference from the older types of trimmer is the long cantilever excavator belt that delivers to one side of the canal only.

The paving machine

Several changes were made in the design of the paving machine, often called the "liner," which is also electrically operated, capable of self-propulsion, and is equipped with hydraulic jacks which raise and lower the machine for grade control.

A notable change is the rearrangement of the equipment to adapt it to use ready-mix concrete delivered by truck mixers. For this purpose, a receiving hopper with a capacity of about 6 cu.yd. is centrally located on top of the paving machine. To this hopper, concrete is delivered by 4 cu.yd. truck mixers with the aid of a truck-mounted conveyor belt traveling on the berm beside the paving machine and keeping pace with it as it moves forward. A concrete distributing car, traveling beneath the receiving hopper, delivers the concrete to compartments over the various sections of the canal perimeter. Deliv-

Fig. 3. The paving machine receives concrete from a procession of 4-cu. yd. truck mixers. Under the hopper, a distributing car receives the concrete and delivers it to the several compartments from which it is moved into place in the paving with the aid of vibrators.

ery into place in the lining is facilitated by tubular vibrators beneath the compartments.

Heretofore, the greatest difficulty encountered in large canal-lining operations has been maintaining the wire mesh reinforcement at the specified depth in the relatively thin concrete slab. For the Coachella contract, a method was adopted that was previously used on the Gila canal in Arizona but which had to be changed materially to adapt it to the larger section on the Coachella canal. This involves the use of two guides consisting of pipes held in position transverse to the center line of the canal, one above and one below the mesh to be guided and held in place.

The upper guide is a relatively simple matter as it required only that a run of 4-in. pipe be welded to the concrete compartments on lines conforming to the canal perimeter. The under surface of this pipe is maintained at wire mesh grade where it keeps the reinforcing from rising above specified grade and also serves as a baffle to restrain the flow of concrete forward of the advancing paving machine.

The pipe that passes under the mesh and supports it above grade, was found to work to best advantage if kept 1 to 2 ft. ahead of the other guide. The pipe on the under side is 2½ in. in diameter and parallels the perimeter of the lined section. It is made to travel with the paving machine by being attached at both ends to the side of the paver carriage frame. This pipe is cut where the bottom meets side slopes and a cable, threaded through the resulting three segments, holds the bottom segment in place while allowing slight articulation.

With the ends of the template rigidly fastened to the paving machine the center segment depends entirely on the cable for support. By fastening both ends of this cable to hoists it is possible to vary the tension and hence to shift the position of the template. To assure the desired lead of this lower guide and to help maintain proper position in transit, ¾-in. pull bars are fastened to the pipe segments on the slopes. One of these can be seen in the foreground, in Fig. 2. These pull bars carry considerable tension when concrete, flowing through the mesh, covers and submerges the lower pipe guide.

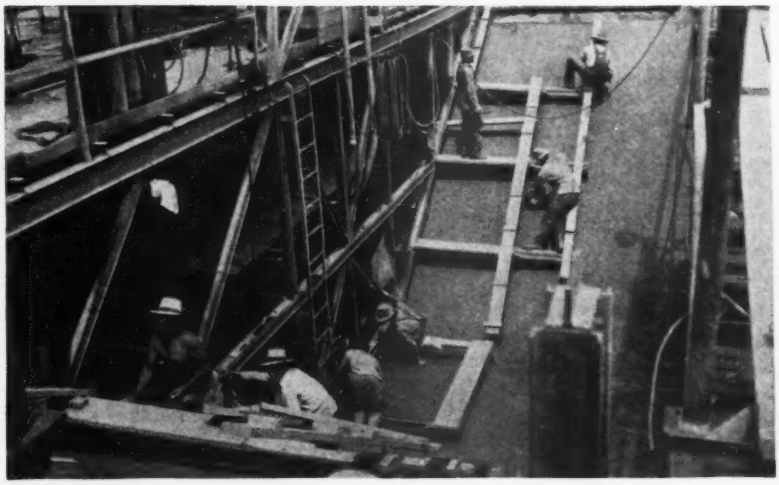


Fig. 4. Finishers' platforms are attached to and project behind the paving machine. Thus finishers have access to the concrete surface immediately after placing. Curing compound jumbo at right.

With two guides thus arranged and by careful attention to maintaining them at grade and with proper lead on the one below, just the right tension and support can be placed in the wire mesh so that it will remain in the proper place in the slab. This results because the mesh is well supported at the time and place where the concrete is delivered and vibrated into place around the mesh.

As originally built, the paving machine had $\frac{3}{16}$-in. sheet steel for finishing plates. These are the plates which pass over the surface of the freshly placed concrete and provide a trowel finish by reason of the weight of the machine. The contractor found it desirable to replace these with ¾-in. plates as a means of obtaining longer service and also to eliminate the slight bulging that was apparent with the thinner steel.

Changes made in the field

It was found that the best location for hand finishing the lining once the machine had passed over it, was immediately behind the paving machine. Accordingly the contractor abandoned the use of a separate finishing jumbo and arranged platforms on the paving machine so that workmen putting the finishing touches on the surface can have access to the concrete immediately the machine moves forward.

Grooving of the fresh concrete surface is done by a hydraulically raised and lowered frame whose bottom edge cuts a ¾-in. groove at 15-ft. intervals. In order to obtain clean-cut grooves, the paving machine is required to leave a near-perfect canal section. Vibrators attached to the member carrying the grooving tool work the tool into the concrete.

Concrete curing is aided by coating the surface with one application of white pigment sealing compound which is spread at the rate of one gallon to 150 sq.ft. For this operation subcontractor S. P. Lyons fabricated a light frame traveler or jumbo that operates on the same track that supports the trimmer and the paving machine.

The concrete mix used for the lining is in the ratio of 1 to 6.70, in which there is 42 percent of sand. The gravel is graded in three sizes: #4-½ in.; ½ in.-1 in.; 1 in.-1½ in. The proportions in which these three sizes are used are 34, 43 and 23, all by percent of weight. The designed strength of the concrete is 3,000 psi.

With the arrangement as described in the foregoing the average run for a 9-hr. shift on the paving machine has been 575 lin.ft. of canal in which the lining is completed in every respect. This represents a batch plant quantity of 455 cu.yd. of concrete. The maximum run was 720 lin.ft. accomplished in about 10 hr.

The work is being done under the direction of the U. S. Bureau of Reclamation, under contract to the J. F. Shea Construction Co., for which W. F. Rennebohm is superintendent.

Statewide Plan Needed on Waste Disposal

INDUSTRIAL wastes were the underlying cause in so many difficulties discussed at the recent meeting of the California Sewage Works Association (*ENR* June 20, 1946, vol. p. 957) that special attention was focussed on a paper entitled "Public Health Aspects of Industrial Waste Disposal" outlining a program for statewide cooperation. The paper, presented by Frank M. Stead, chief, Division of Environmental Sanitation, State Department of Public Health, examined the subject from the broadest aspect and suggested a general plan for remedy. Highlights of the paper are:

Rapid industrialization of the West Coast during the war has been such as to foster some fear that the price to be paid for this industrial development may be the pollution of surface and underground waters and perhaps also of the land and the atmosphere. Reaction to this fear has been a tendency to set up barriers and restrictions that tend toward freezing out new industry and confiscation of existing industry.

Industry must help solve problem

This is unfortunate because it results in a similarly defiant attitude on the part of industry quite opposite to a willingness to cooperate, which is a prerequisite to the kind of solution desired. The comprehensive and enduring solution to be sought must in large part be worked out by each industry itself.

A logical starting point is to examine and to consider separately the six principal types of industrial wastes, namely: Liquid organic, liquid mineral, solid organic, solid mineral, particulate aerial and gaseous aerial wastes.

The liquid wastes, in varying degree, cause oxygen depletion in receiving bodies of water, decompose with the resultant formation of hydrogen sulphide, set up corrosion in pipelines and structures, destroy fish and other aquatic life, ruin recreational value of waters and render water unfit for domestic, industrial and irrigation use.

The solid wastes may result in fly breeding, cause odor nuisances and by leaching action ruin the usefulness of surface and undergound waters or the surrounding land.

Both particulate and gaseous aerial wastes (dusts, fly ash, smoke, acid mists and gases) damage buildings, drapery and clothing and cause irritation of eyes, nose and throat.

The importance of considering all of these causes and effects jointly is apparent when it is remembered that wastes of one type often may be converted into another type. Thus an agency concerned with only one of the nuisances might accomplish its objective but by so doing pass the problem along in another form.

Another point to be considered is that some industrial wastes, because of their magnitude and quality, would be so expensive to purify that waste disposal alone could easily reach a figure greater than the actual cost of production. In such cases solution of the problem is in prevention rather than "cure." Sometimes the segregation of troublesome wastes by recirculation or by change of the process itself may keep the effect within reasonable bounds. The decision to undertake this, however, must come from the industry itself.

Coordinated attack needed

Consideration of these several broad aspects of the matter suggests the pattern that must be followed by any successful regulatory program. namely, it must (1) comprehend all types of industrial waste, (2) provide protection against all types of damage to the environment and (3) make industry a party in the solving of the problem.

California today has many different official agencies both at the local and the state level that have a stake in the waste disposal problem. However, each agency is officially concerned with only a portion of the problem. The need, therefore, is to coordinate activities.

That endeavor should be carried forth under the Health and Safety Code of the state, which already provides for the regulation of waste disposal. In fact, existing regulations make the State Department of Public Health the only agency legally able to cope with all types of industrial wastes. While heretofore concerned principally with municipal sewage treatment and disposal, it is the intention of the State Department of Health to extend the permit system to include at least the more important industries that dispose of their liquid wastes separately and also to take account of the disposal of solid and aerial wastes.

Basic policies outlined

In this program the department will be guided by three fundamental concepts:

(1) There must be a regional philosophy behind the requirements. Usually, account must be taken of all uses of land and water in an area and the regulation made only as severe as the circumstances of each area justify.

(2) The rights of future industry must be borne in mind. For example, it is not fair to assume that the first industry to locate on a river should be allowed to preempt the full capacity of that river to receive industrial waste.

(3) Recognition should be given to the prospect that standards with respect to industrial waste disposal will be progressively upgraded as years go by, partly as a result of a disappearance of isolation for industry and partly in order to realize the full possibilities of recreational resources.

The State Department of Public Health program will be of greatest value, it is believed, if it is flexible enough to serve as an instrument of leadership for the various interests involved and as a means of interpreting the mutual needs and desires of industry, cities and of the people.

HIGHLIGHTS IN DESIGN OF

Three Immense Auto Assembly Plants

***Contents in Brief**—In the design of three steel-frame automobile assembly plants with main-floor working areas each exceeding one million square feet in area, the use of continuous girders for supporting the roof, conveyor loads and second-floor equipment was found economical. The great quantities of air exhausted from the buildings by processing equipment and the flat roofs without monitors made ventilation a problem.*

ABOUT 1,300,00 sq. ft. is being placed under a single roof at Wilmington, Del., at Framingham, Mass., and at Atlanta, Ga., for the assembly of General Motors Corp. Buick, Oldsmobile and Pontiac automobiles. In designing the two-story steel-frame structures for efficient production, imposing problems in lighting, heating and ventilation, as well as in structural design, were met and solved.

The three projects were designed along the same general pattern and are of about the same size, with straight-line flow of assembly and sub-assembly operations. The plant at Wilmington is slightly larger than the others and will have a capacity of 50 cars per hour when in full production. It is about 800x1,300 ft. in plan, with a second floor one-third the area of the first floor. The buildings under way at Atlanta and Framingham, Mass., are, respectively, about 855x1,055 ft. and 965x1,145 ft.

Plant interiors are planned in such a way that all materials will move through the buildings in a most direct and efficient manner, to produce a maximum of manufacturing units in the shortest possible time with the least amount of labor. Promoting flexibility of layout by facilitating the connection of numerous conveyors and other equipment and making relocation simple, all girders are set with bottom flanges level. Large clear working areas are provided by typical panels of 45x45 ft., formed by trusses at 45-ft. centers supporting continuous girders spaced 15 ft. apart (Fig. 2). Minimum clear height is 20 ft.

The second floor houses the paint-mixing, the bonderizing and some oven equipment. At the Wilmington plant, a large area above the second floor, called the penthouse, contains the air make-up fan units and special paint ovens.

At the front of the assembly plant (Fig. 1) and connected to it by a two-story passage is the office building. Between the two structures and at the same floor level as the assembly plant is an area 65x800 ft. set aside for the personnel department, hospital, cafeteria, office and executive dining rooms, kitchen, garage, and employees' wash and locker rooms. The office structure is V-shaped in plan for good lighting and better access to the kitchen receiving room on one side and the garage on the other side

All photos Albert Kahn Associated Architects & Engineers, Inc.

Fig. 1. The automobile assembly plant under construction at Wilmington, Del., is typical of three being built to provide at each site over one million square feet of working area, but is slightly larger than the others.

Fig. 2. Columns supporting the second floor of the Wilmington plant are 45 ft. apart. Continuous girders are carried by vertical members of the trusses.

of the connecting wing between office and personnel buildings. Connected at the rear of the assembly plant is a 90x135-ft. shipping building.

The power houses at Framingham and Wilmington are designed for future expansion and for possible conversion from fuel oil to powdered coal. Because of the availability of natural gas at Atlanta, there is no central heating plant on this project, all heating in the assembly building being designed for individual natural-gas-fired unit heaters.

The assembly plant has a structural steel frame with metal deck roof and concrete floor slabs. Typical slabs are 5 in. thick at Atlanta and Framingham, 5½ in. at Wilmington. Exterior walls are of brick and glass, with stone trim in the office building. Office partitions are metal and glass. The walls of the kitchen, cafeteria and office dining room are lined with glazed tile, but the executive dining room is finished in wood.

Fig. 3. Girders cantilever at one end beyond truss supports and are supported at the other end by adjacent cantilevered girder.

Cantilever design found economical

Considerable economies were effected as a consequence of the design selected for the girders. Each girder is seated on a vertical member of the truss but at one end projects beyond 6 ft. 3 in. (Fig. 3). The opposite end is connected to the cantilevered end of the similarly supported, adjacent girder. These members were designed as cantilevers with a concentrated conveyor load of 6 kips at any point and the live load of floor or roof so distributed as to produce maximum moment. Under these conditions, the saving in weight of girders over simple-span construction amounts to from 16 to 27 percent depending on the proportion of live and dead load.

At the Wilmington plant, typical roof girders are 21 WF 59 and 63, carrying 30 psf. live and 48 psf. total load in addition to the conveyor load. Typical second floor girders are 33WF 125 and 132, supporting 125 psf. live and 215 psf. total load in addition to the conveyor load. The total weight of steel is 13.4 psf. of ground projection. For the one-story section, the weight is only 10.2 psf. The three projects required about 21,000 tons of structural steel.

For erection it is necessary that a definite schedule be followed. The end girders cantilever past the first interior column line. Then, all following girders connect to the cantilevered end of the previously erected girder and project through the next interior truss. No difficulty has been experienced in erection.

Roof pitched by blocking

Roof purlins are parallel to the trusses and horizontal. The pitch of the roof is produced by blocking up the purlins above the girders on plates or beam sections varying from 2 to 10 in. in depth (Fig. 4). At the column lines, the roof deck is supported directly on the top chords of the trusses. At the low point of the roof, the deck is carried on a sloping angle to form a gutter with suitable pitch. The structure is divided by

expansion joints at about 450-ft. intervals.

Because of the flat roofs without monitors and because of the tremendous amount of air exhausted from the buildings by the processing equipment, the assembly plants have a definite problem in the way of ventilation.

The equipment consists mainly of ovens and spray booths, some of which are located on the second floor, but the majority of them including the spray booths, are on the first floor. To make up this exhausted air, which amounts to about 900,000 cfm. for first-floor paint and spray areas, there are 18 supply units of 52,000 cfm., each of which draws air in from outside, heats and filters it before discharging the clean air into the tile-wall enclosed paint and spray areas. In the summer these units perform the same operation with the heating coils not being used since they are not needed in that season.

Summer exhaust large

In the remainder of the factory area, there are various small pieces of equipment that exhaust a total of 240,000 cfm. of air from the building. This air is replaced by 14 unit ventilators complete with steam coils, intake hoods, fans, dampers, and other accessories, and each unit has a capacity of 20,000 cfm., making a total of 280,000 cfm. winter supply, which, of course, gives a slight pressure in the building.

The summer requirements for the main portion of the factory, however, exclusive of the paint and spray area, amounts to quite a problem, since there is the interior heat to dissipate plus a very heavy sun load on the roof. The air required to maintain a temperature of not over 10 deg. higher than outside amounts to some 800,000 cfm. exhaust. To accomplish this, 30 roof exhaust ventilators are installed with a capacity of 20,000 cfm. each, making a total of 600,000 cfm. exhausted through these units in addition to the 240,000 cfm. process exhaust.

To replace this air, a number of summer supply unit ventilators are installed with discharge ducts extended down to the bottom chord of the trusses to introduce this air as low as possible. The winter supply units are also used in the summer with the steam turned off. Both these groups total about 640,000 cfm., which makes a slight vacuum in the building and causes an inrush of air when the windows and doors are opened. In addition to this, the office sections, cafeteria, locker rooms and other rooms in the office personnel building are completely ventilated with provision for future cooling when that is necessary for the comfort of the personnel.

Power and lighting equipment

The electrical installations for these buildings utilize the latest equipment. All substations are of the unit type, with double-ended transformers and the secondary switchboards directly connected. Switchboards are of the metal-clad draw-out type with air circuit breakers. Each building has four unit substations, each in its own enclosure located on the roof, fed from a master primary substation located in the boiler house. Primary service is brought to the master substation by the local power company from overhead lines.

For flexibility, bus duct is used throughout the plant for the power system. Secondary power is 460 volts, 3 phase. From this source lighting is taken through dry-type transformers at 230/115 volts, single phase. These lighting transformers are of the small type, averaging 37.5 kva. each, and are balanced across the system.

Industrial lighting is divided into two groups—general and process, or work lighting The latter is suspended on trolley duct on a special framework 7 ft. 6 in. above the floor, with 100-watt continuous fluorescent reflectors set at an angle and providing about 50 foot-candle intensity on each side of the production conveyors.

Mounted on a messenger cable system at the truss line, 20 ft. above the floor, the general lighting fixtures are 400-watt mercury reflectors, giving about 18 foot-candle intensity.

In the office building, where fluorescent lighting is used throughout to provide an average of 30 foot-candles, metal deck floor construction permits the use of underfloor wiring for all telephone and 110-volt wiring.

The builders

The three projects were designed by Albert Kahn Associated Architects and Engineers, Inc. General contractors are Gust K. Newberg Construction Co. of Chicago, Ill., at Atlanta; Gilbane Construction Co. of Providence, R. I., at Framingham; and Consolidated Engineering Co. of Baltimore, Md., at the Wilmington, Del., plant.

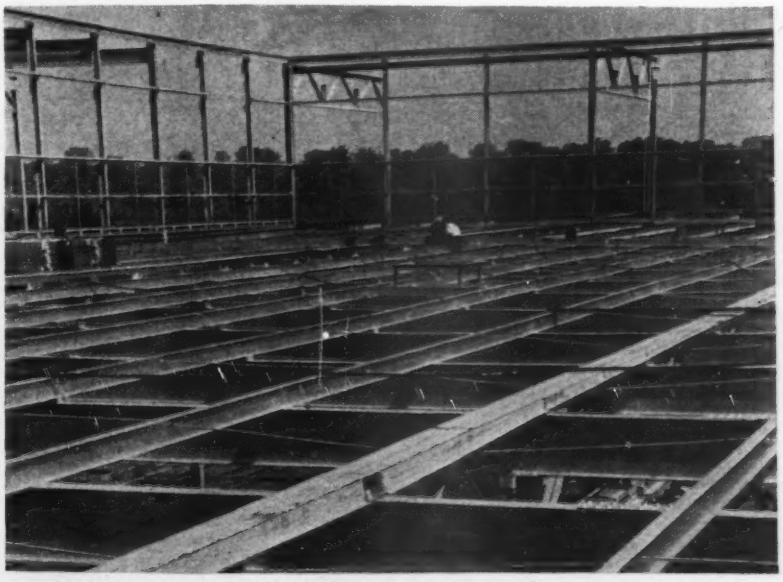


Fig. 4. Roof pitch is produced by blocking the purlins up on plates or beam sections. At the column lines, the metal roof deck is supported on the top chord of the trusses. The deck is carried on a sloping angle to form a gutter at the low point of the roof.

Shop-Built Equipment Aids In Studying Highway Paints

ENGINEERS of the Virginia Department of Highways are finding two shop-built tools—an abrasion machine and an accelerated weathering machine—of great value in studying the properties of paints used for marking the center lines of highway pavements and for other purposes.

The abrasion machine (Fig. 1) consists of a 24-in. dia. cast aluminum turntable on which are bolted twelve plates all of the same size to form a continuous cover for the table. The plates are quickly removed for painting, thus making it possible to test several kinds of paint simultaneously. The turntable is revolved at a constant rate of 32 rpm. by a ¼-hp. electric motor through friction gears enclosed in a cast aluminum gear box, an automatic counter recording the revolutions of the table during each test period.

The 12-in. dia. cast iron wheel shown mounted above the table is made up in sections to permit replacement of its rubber tire, which is of the same type of rubber as ink erasers and lasts for many hours of operation. The wheel is revolved through friction with the turntable. As a given point on a plate approaches a position directly under the wheel and as it leaves this position some slippage between this spot and the wheel must occur. This action produces a constant wear on the paint surfacing of the plates. By noting the number of revolutions to completely wear through various paints tested in the same manner, a good comparison of the wearing qualities of each is believed to be obtained.

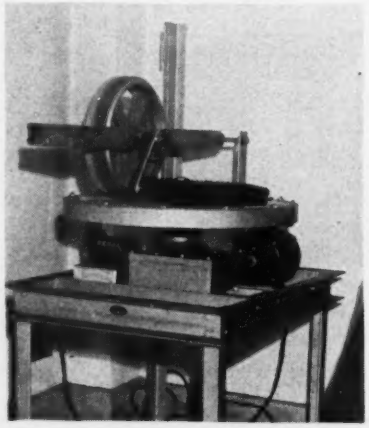


Fig. 1. Wearing qualities of paints used for markings on Virginia highway pavement are evaluated with the above abrasion machine.

If desired, the rate of wear may be increased by applying pressure on the outer end of the pivoted arm on which the wheel is mounted. Also, the wheel and its supporting arm may be shifted sidewise to change the wheel's path and thus alter the rate of wear, the wear for a single cycle increasing as the wheel is shifted toward the center of the table.

The brush shown above the table is driven by a belt connection to the abrasion wheel. This brush serves to remove all particles from the top of the table that are formed by the abrasive action of the wheel and which would accelerate the rate of abrasion.

The accelerated weathering machine (Fig. 2) may be used in conjunction with the abrasion machine, the paints to be tested being applied to plates or panels of the type readily bolted to the turntable. The drum of the weathering machine is 3 ft. in dia., and 3 ft. long and is rotated by a ¼-hp. electric motor at a rate of two revolutions per hour. The drum revolves in a water bath of sufficient depth to cover the panels to a depth of 1 in. at their lowest point of travel.

A high ultra-violet emission quartz mercury tube 24 in. long is mounted at about the center of the drum, a wire screen being mounted about the tube to keep it from being broken by any of the test panels that might become disconnected. When the machine is in use a cover equipped with a dark glass window to permit an observer to view the contents of the drum is installed at the front of the drum.

During a test the temperature within the drum remains high because of the heat given off by the ultra-violet tube. The heat and moisture in combination with the intense ultra-violet light, which is considered a major factor in the weathering of paints, provides a good test of the weathering properties of various paints.

Both tools have been in use seven years and have been considered worthwhile investments. They were built and are used under the direction of C. A. Franklin, a chemist with the Virginia Department of Highways.

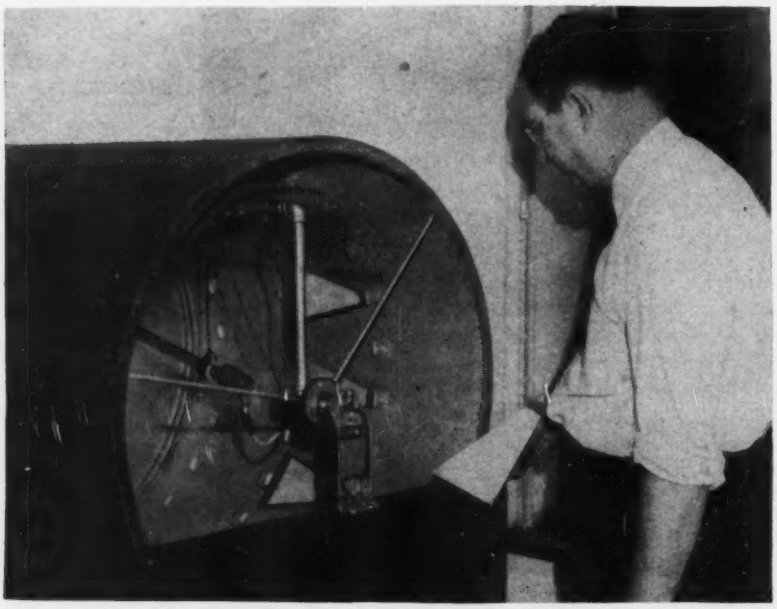


Fig. 2. Weathering properties of the paints are indicated upon exposure to intensive ultra-violet light, the test panels being attached to the shell of the drum and passing through a water bath at their lowest point of travel.

From Field and Office

WORKING PROBLEMS AND TIME-SAVING METHODS FOR ENGINEERS AND CONTRACTORS

Cinder Block Replaces Tile On Hospital Project

In building a 400-bed, six-story reinforced concrete frame hospital to be operated by George Washington University in Washington, D. C., hollow tile could not be obtained for construction of the tile and joist floors so the general contractor, the Charles H. Tompkins Co., was permitted to substitute hollow cinder block. The results have been entirely satisfactory and much better advancement has been made than would otherwise have been possible.

The typical floor panel measures about 18 x 20 ft. and the spacing of the joists, which are 6 in. wide, is 24 in. Two sizes of light-weight cinder block, 4 x 8 x 18-in. and 6 x 8 x 18-in., are used, the smaller size being installed where conduits are required (Fig. 1). Concrete with a minimum strength of 2,500 psi. is used for the joists and to provide a minimum thickness of 2 in. over the thickest block. Later, 1½-in topping of 3,500-lb. concrete is added to complete the floor, which is designed for a live load of 40 lb. per sq. ft. Removal of the forms reveals that all of the blocks are rigidly secured in place.

Construction of the hospital has also been speeded up by providing a mono-rail along all sides from which to suspend the scaffolds as well as the chain hoists used in setting the stone facing for the structure (Fig. 2). By supporting the scaffold and the hoist on the same rail the two are readily moved along as work advances and much better progress results than if the scaffold were suspended in the normal manner.

The $4,000,000 hospital is being built by the Public Buildings Administration for which Carroll A. Warthen is construction engineer. Joseph Toomey is general superintendent and Patrick G. Caton engineer on the job for the contractor.

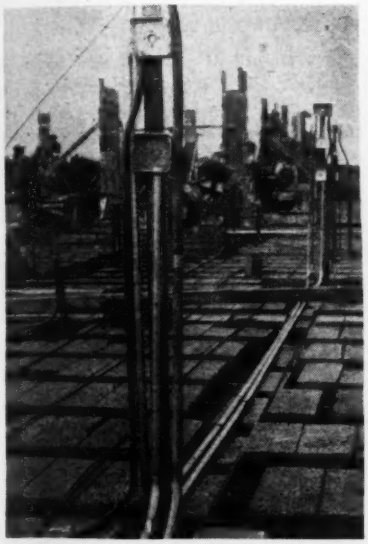


Fig. 1. Use of cinder block, rather than unobtainable hollow tile, in building floors of a hospital in Washington made it possible for the work to go ahead without serious delay.

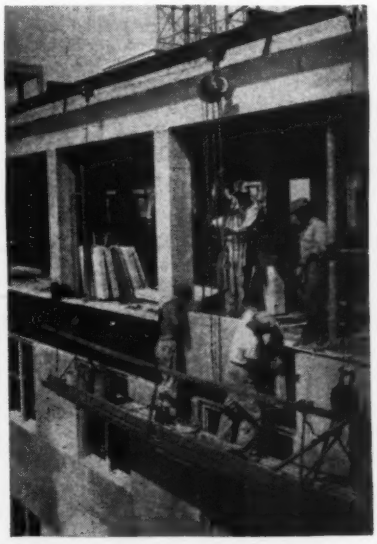


Fig. 2. Installation of stone facing for exterior walls was simplified by suspending hoists and scaffolds from monorail installed at top of walls for their full length.

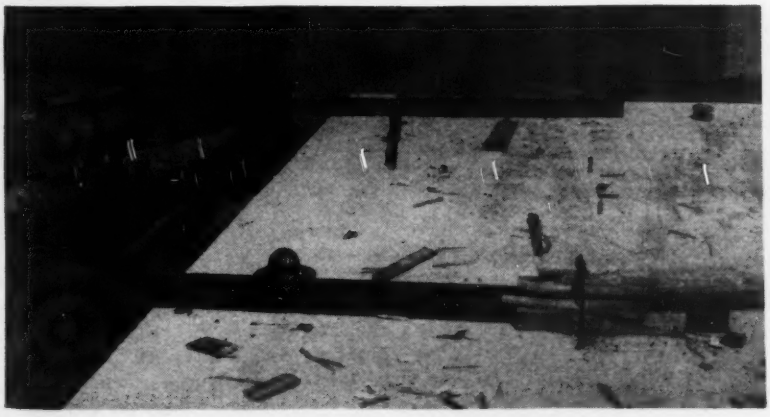


Fig. 3. At the top of the building, the monorail was attached to short steel beams, each of which was tied down with two bolts passing through the roof.

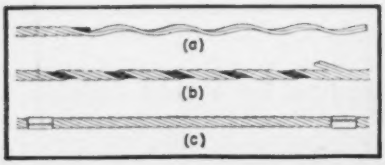
Reeving a New Wire Rope

When replacing an old and worn wire rope with a new one, on any machines which requires pulling the new rope through blocks, over sheaves and on to drums, the following method will save time, temper and money.

From the end of the old rope, unlay and remove four of the six strands to a distance of about two or three feet as shown in (a) of the accompanying drawing. Similarly, as shown in (b), remove two of the six strands from the new rope to be installed.

Splice, or more properly speaking "lay" the two together and tape the

ends to prevent unravelling. This will permit the new cable to be pulled through block and pulleys and reeved rapidly, accurately and easily.



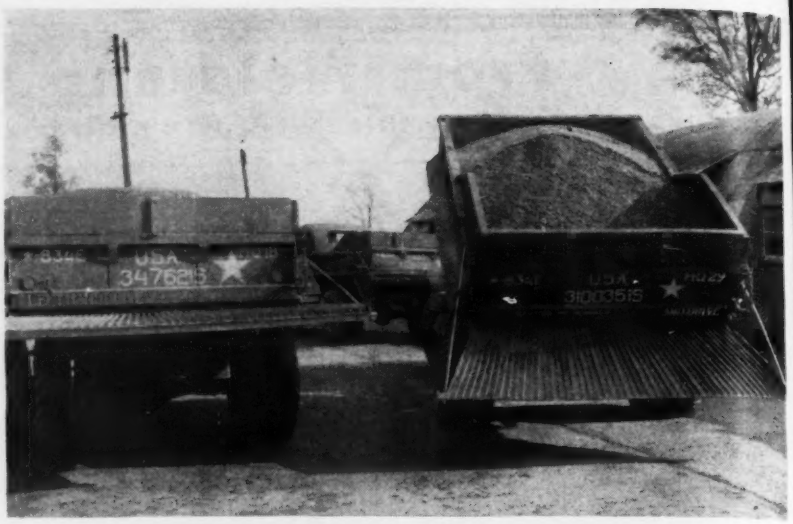
Three simple steps in splicing new wire rope to old for rapid, accurate and easy reeving.

This, of course, can be done only with preformed wire rope, since it is only that type of wire rope that has strands which will lie inert. To remove the seizing wires and attempt this procedure with non-preformed wire rope would be courting disaster, since ordinary wire rope, so cut, would virtually explode.

Weed Killer

The "homemade" spray rig shown below is a three-section affair that can be made with wood or metal, or a combination of both, usually available in road maintenance shops. It is suitable for applying weed killing spray such as 2, 4 dichlorophenoxyacetic acid along highways.

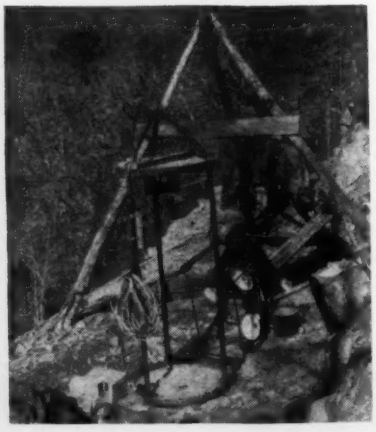
The two end sections are hinged to the center section to permit free movement with the contour of the ground. Either end section is removable so that it is simple to detach one and use the center and the other end for spraying weeds along road shoulders. Spray nozzles on the boom provide a fan-like spray and are so arranged that each gives a 50 percent overlap with adjoining sprays.—Dow Chemical Co., Midland, Mich.

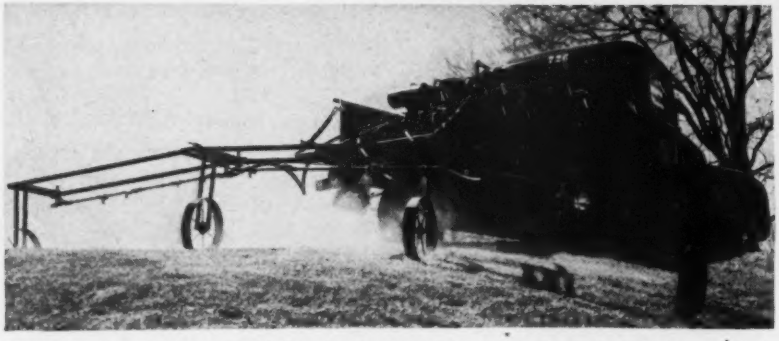


SHOP-BUILT SPREADER SIMPLIFIES ROAD WORK

A welder spreader of the type illustrated above simplified and speeded up paving operations of the Aviation Engineers in the Pacific. The shop-built device proved highly successful in spreading crushed stone for the wearing course and is considered to offer some advantages to state highway departments. The device, which may be attached to the truck, was designed and built by Sgt. John Hackett of the 834th Engineer Aviation Battalion.

Camera Memoranda for Photographing Rock Formations

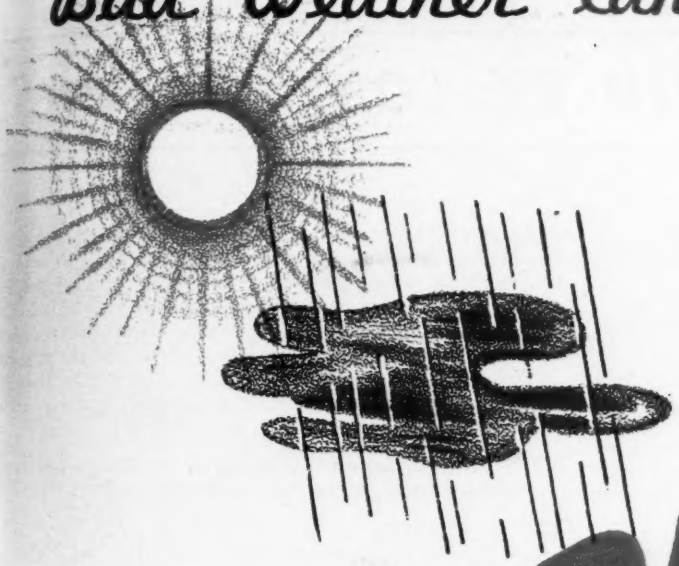




Spray rig for liquid weed killer chemicals can be made from job shop materials.

A special cage (in close-up at left, above) holds camera at fixed focus and photographic flood lights for taking pictures of rock formations in 36 in. dia. cored exploration holes at the Narrows Dam site on the Little Missouri River above Murfreesboro, Ark. The camera cage is used above or below a man cage (shown at the right), which is lowered by cable into the bore hole. (Pictures from the U. S. Army Engineers, Vicksburg Engineer District).

Bad Weather can't stop 'em!

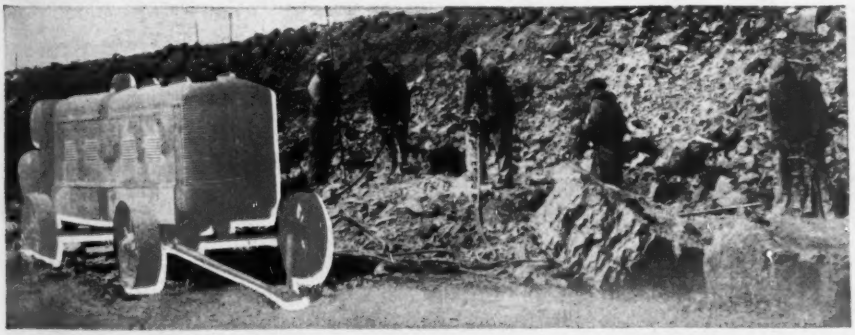


AIR COMPRESSORS made by SCHRAMM

Heat—rain—dust—frost—all the difficult weather conditions encountered in 'round-the-year operation do not impair the high working efficiency of SCHRAMM Air Compressors.

SCHRAMM completely water-cooled machines function perfectly even with the compressor doors locked, thereby eliminating the hazards of grit, dust and theft.

SCHRAMM portable or stationary units are compact, light-weight and push-button controlled, provide *continuous* operation, and show record economies in operating and maintenance costs.



SCHRAMM No. 315 Air Compressor operating three heavy-duty jackhammer drills.

Quarry operations powered by a SCHRAMM Air Compressor.

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UNIT PRICES BID BY CONTRACTORS

Gravel Road, Norway and Waterford, Maine

OWNER: State Highway Commission, Augusta, Maine, Lucius D. Barrow, Chief Engineer.

PROJECT: Construction of a gravel road, 2.178 miles long, between Norway and Waterford, Maine.

CONDITIONS: All materials to be furnished by contractor. Contract time is 100 calendar days. Stipulated minimum wages are $1.00 per hour for skilled labor, $.80 per hour for semi-skilled trades, and $.66 per hour for common labor.

BIDS: Bids, taken July 17 at Augusta, Maine, ranged from the contract low of $48,325 to $58,095.60.

LIST OF BIDDERS:

1. W. E. Rogers, Gardiner, Maine (contract) $48,325.00
2. P. E. Suci & Co., Pittsfield, Maine 50,620.00
3. W. Simpson Const. Co., Augusta, Maine 58,095.60

Item	Quantity	Unit Prices (1)	(2)	(3)
11. Clearing and grubbing	3.2acres	$250.00	$300.00	$500.00
12a. Earth excavation	21,300 cu. yd.	.60	.65	.70
12b. Rock excavation	500 cu. yd.	2.00	3.00	2.50
12e. Trees removed	15 ea.	20.00	25.00	20.00
13. Excavation for structures	320 cu. yd.	3.00	2.00	2.00
17a. Common borrow	1,000 cu. yd.	.50	.55	.60
24a. Gravel base course	14,000 cu. yd.	.75	.85	1.30
24b. Base outlets	100 cu. yd.	2.00	1.25	2.00
33a. Surface treated gravel course	1,950 cu. yd.	2.00	1.50	2.00
33b. Bituminous material	16,500 gal.	.19	.20	.16
42a. Class "A" concrete	22 cu. yd.	35.00	30.00	28.00
42b. Class "B" concrete	17 cu. yd.	32.00	30.00	26.00
43. Steel reinf. for con. structures	2,400 lb.	.10	.10	.10
47c. 12" corr. metal pipe	184 lin. ft.	1.50	1.50	1.50
47d. 15" corr. metal pipe	48 lin. ft.	1.75	1.75	2.00
47e. 18" corr. metal pipe	24 lin. ft.	2.25	2.00	2.50
48e. 18" asphalt coated metal pipe	310 lin. ft.	2.50	2.25	2.70
48g. 24" asphalt coated metal pipe	260 lin. ft.	3.50	3.50	4.00
48h. 30" asphalt coated metal pipe	144 lin. ft.	5.00	5.00	5.00
48i. 36" asphalt coated metal pipe	54 lin. ft.	7.00	6.00	6.40
53. Plain riprap	350 cu. yd.	5.00	5.00	3.50
55b. Underdrain—Type B	200 lin. ft.	2.00	2.50	3.00
55g. Underdrain outlets	100 lin. ft.	1.00	1.50	2.00
65a. Wire cable guard rail—Type "A"	1,200 lin. ft.	.90	1.10	.80
65c. Anchorages	14 ea.	15.00	25.00	15.00
65e. Anchorages (special)	4 ea.	20.00	30.00	30.00
76a. Relaying 12" corr. metal pipe	32 lin. ft.	.50	1.00	1.00
76b. Relaying 18" corr. metal pipe	26 lin. ft.	.50	1.50	1.00
67b. Loam borrow	100 cu. yd.	3.00	2.00	2.50
68. Sodding	100 sq. yd.	1.00	1.00	1.00
69. Project markers	2 ea.	10.00	20.00	15.00
70. Right of way monuments	30 ea.	10.00	10.00	10.00
75. Gravel overhaul	51,300 yd. mi.	.10	.10	.10

Nut Island Sewage Treatment Plant, near Quincy, Mass.

OWNER: Metropolitan District Water Supply Commission (Massachusetts).

PROJECT: Construction of aeration and sedimentation tanks, influent and effluent conduits, main building foundations, grit storage tower foundations, grit channels, comminutor facilities, pump sump, foundations and settings, and appurtenant work. Total project involves 2,000,000 yards of reinforced concrete work.

CONDITIONS: The Metropolitan District Water Supply Commission will furnish 1,200,000 lb. of metal work and equipment which must be transported and installed by the contractor. Contract was awarded August 6, 1946 and is scheduled for completion October 31, 1947. Wage rates for crane, shovel, and drum machine operators are $2.025 per hour; for cement and asphalt finishers, stone masons, electricians, iron workers, plumbers, steamfitters, and sheet metal workers, $1.725; composition roofers, $1.65; pile drivers, $1.60; carpenters and stone cutters, $1.50; and common labor, $1.15.

BIDS: Five bids were received July 31, 1946, ranging from the contract low of $1,179,763.20 to $2,108,441.15.

LIST OF BIDDERS:

1. V. Barletta Co., Roslindale, Mass. (contract) $1,179,763.20
2. Henry N. Worthington & Co., Quincy, Mass. 1,309,077.98
3. Marinucci Brothers & Co., Dorchester, Mass. 1,360,546.60
4. Gahagan Const. Corp., Boston, Mass. 1,459,468.50
5. M. De Matteo Const. Co., Quincy, Mass. 2,108,441.15

Item	Quantity	Unit Prices (1)	(2)	(3)
1 Excavation	40,000 cu. yd.	$1.50	$3.00	$1.80
2 Refill and embankment, unconsolidated	25,000 cu. yd.	.50	2.00	1.10
3 Refill and embankment, consolidated	3,000 cu. yd.	1.00	3.00	1.30
4 Crushed stone and screened gravel	2,000 cu. yd.	3.50	4.50	2.50
5 Gravel	500 cu. yd.	2.00	2.25	2.00
6 Conc. in sedim. and aeration tanks	10,000 cu. yd.	33.50	26.00	34.00
7 Conc. in influent and effluent conduits	4,300 cu. yd.	33.50	28.00	34.00
8 Conc. in grit channels and main building substructure	5,700 cu. yd.	33.50	26.00	39.00
9 Expansion and vibration joint filler	1,500 sq. ft.	.30	.30	1.00
10 Rubbed finish	18,000 sq. ft.	.15	.15	.20
11 Portland cement	32,000 bbl.	3.00	3.75	3.16
12 Reinforcing steel	2,500,000 lb.	.065	.08	.08
13 Light steel work	175,000 lb.	.30	.45	.28
14 Cast iron pipe and specials larger than 6 in.	32,000 lb.	.15	.19	.17
15 Cast iron pipe and spec. 6 in. and under	15,000 lb.	.15	.18	.16
16 Miscellaneous ferrous metals	5,000 lb.	.60	.75	.52
17 Galvanizing	160,000 lb.	.05	.08	.06
18 Misc. non-ferrous metals	12,000 lb.	1.10	1.55	1.00
19 Miscellaneous lumber	15 M.ft.B.M.	300.00	230.00	200.00
20 Tile pipe, 8 in. and under	700 lin. ft.	5.00	1.50	2.00
21 Tile pipe, 10 in. to 15 in. (incl.)	500 lin. ft.	5.00	3.00	3.00
22 Precast reinf. concrete pipe	900 lin. ft.	5.00	4.00	5.00
23 Transporting, caring for and setting metal work and equip. furn. by the Commission	1,200,000 lb.	.03	.08	.06
24 Connections to existing high level sewer	lump sum	10,000.00	7,500.00	11,000.00
25 Electrical conduits	lump sum	8,000.00	8,077.00	9,000.00
26 Cleaning	lump sum	2,500.00	5,000.00	6,000.00
27 Furn. perform. bond	rate per $1,000	8.00	15.00	15.0

Surfacing, St. Helens Highway, Washington

OWNER: Public Roads Administration, District No. 1, Portland, Oregon, W. H. Lynch, Engineer.

PROJECT: Bituminous surfacing of 12.908 miles, 20 ft. pavement, 24 ft. shoulder to shoulder, St. Helens Highway, Columbia National Forest, Cowlitz-Skamania Counties, Washington.

CONDITIONS: Transportation by rail to Castle Rock and by highway from Castle Rock to job site. Crushed rock furnished by government. Contract time. 155 calendar days. Wage rates are $1.55 per hour for skilled labor, a range of $1.35 to $1.55 for semi-skilled labor, and $1.15 to $1.35 for common labor.

BIDS: Only two bids were received July 23, 1946 at Portland, Oregon, the low bid of $169,138.50 and the high of $174,081.50.

Surfacing St. Helen's Highway, Washington

Continued from preceding page

LIST OF BIDDERS:

1. J. D. Shotwell, Tacoma, Wash. (contract) $169,138.50
2. Peter Kiewit Sons Co., Seattle, Wash. 174,081.50

Item	Quantity	Unit Prices (1)	Unit Prices (2)
2 Maintenance as authorized	all reqd.	$500.00	$500.00
3 Extra & misc. force account work	all reqd.	1,000.00	1,000.00
24(1) Unclassified excavation	500 cu. yd.	1.00	.90
26(1) Unclass. excavation for borrow, case 1	2,000 cu. yd.	1.00	.55
27(2) Overhaul (1000' free haul)	5,000 sta. yd.	.03	.02
28(2) Special overhaul of borrow (1000' free haul)	5,000 c. y. mi.	.20	.25
43(1) Fine grading subgrade and shoulders	6,168 mi.	750.00	375.00
45(2) Watering of subgrade	200 units	2.00	2.30
45(3) Watering of base course	900 units	2.00	2.30
45(4) Watering of surface course	400 units	2.00	2.30
45(5) Providing and main. water plant or plants	all reqd.	500.00	450.00
45(6) Watering of base course	200 units	2.00	2.30
46(1) Pit-clearing	3 acres	200.00	500.00
46(2) Pit-stripping	1,000 cu. yd.	.25	.25
82A(1) Cr. gravel or cr. stone base crse., cl. (2), gr. (B-1)	18,000 cu. yd.	2.50	2.40
88(1) Reconditioning of used roadbed	6,740 mi.	500.00	525.00
102(1) Cr. gravel or cr. stone surf. crse., cl. (2), gr. (C)	9,000 cu. yd.	3.00	2.60
110(4) M. C. cutback asphalt gr. (2) for prime coat	240 tons	42.50	40.00
114(1) (Cl. A pavement) aggregate for designation (AT-126) surf. treat	9,200 cu. yd.	3.15	5.10
114(5)R. C. cutback asphalt gr. (3), for class A surf. treat	205 tons	42.50	40.00
114(9) Asphalt, gr. (150-200) for cl. A surf. treat	660 tons	47.50	40.00

Dearborn Street Subway, Chicago, Illinois

OWNER: City of Chicago, Department of Subways and Superhighways, Dick Van Gorp, Chief Engineer.

PROJECT: Construction of complete Dearborn St. subway, starting from Dearborn and Van Buren Sts., where shields have been left in ground, and continuing to Congress St., then west on Congress St. to the east bank of the south branch of the Chicago River.

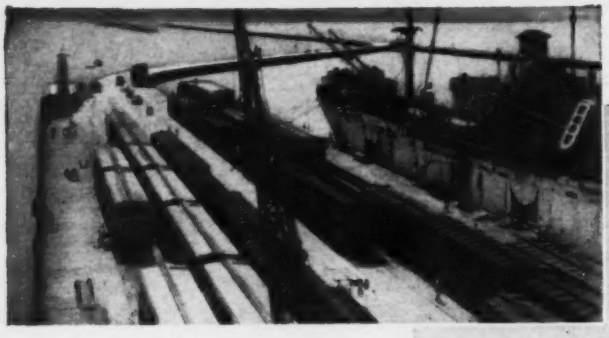
CONDITIONS: Some shoring of buildings is expected. All materials are to be furnished by the contractor. Stipulated contract time is 540 calendar days. Skilled wages range up to $2.25 per hour, and semi-skilled, to $1.60, while common labor wages are $1.30 per hour.

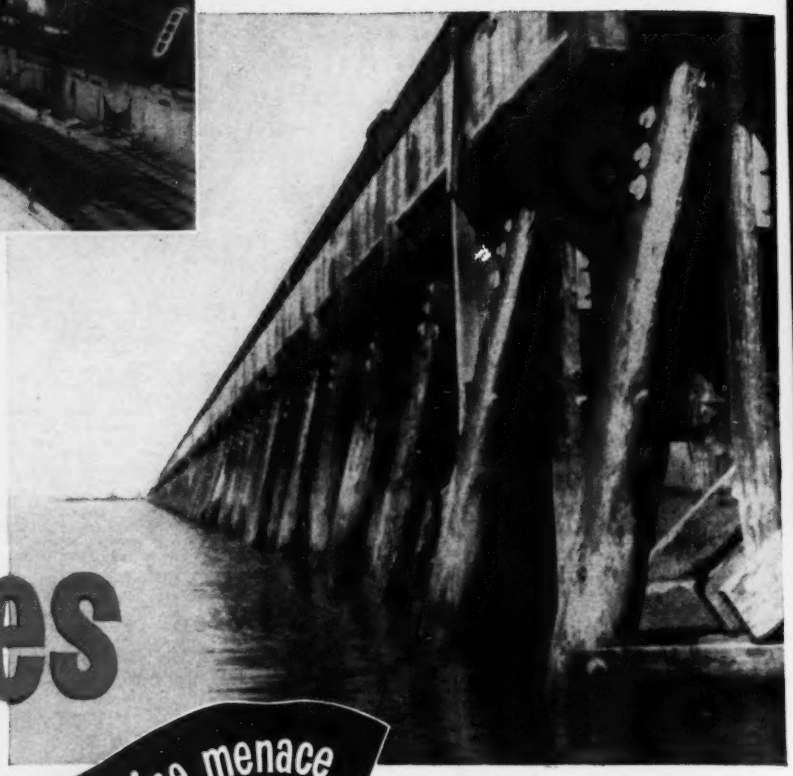
BIDS: Three bids were received August 29, 1946, ranging from the low bid of $8,235,134.50 to $8,962,760.00

LIST OF BIDDERS:

1. S. A. Healy Co. and Peter Kiewit Sons Co., Chicago, Ill. $8,235,134.50
2. Michael Pontarelli, Inc., Chicago, Ill. 8,754,220.00
3. M. J. Boyle & Co., Chicago, Ill. 8,962,760.00

Item	Quantity	Unit Prices (1)	Unit Prices (2)	Unit Prices (3)
G-1 Station tube section	530 lin. ft.	$1,830.00	$2,330.00	$1,850.00
G-2 Single tube sec., 20'-9" internal diam.	1,555 lin. ft.	1,240.00	1,240.00	1,580.00
G-3 Excavation in open cut for crossover, mezzanine station and station tube sect.	28,000 cu. yd.	20.00	20.00	19.00
G-4 Excavation in open cut for aux. structures	3,450 cu. yd.	22.00	23.00	20.00
G-5 Excavation in tunnel for special structures	1,000 cu. yd.	15.75	20.00	25.00
G-6 Removal of freight tunnels and any other concr. in tunnels	720 cu. yd.	50.00	35.00	75.00
G-7 Sand backfill in open cut	8,300 cu. yd.	3.00	2.50	3.00
G-8 Sand backfill in tunnel	500 cu. yd.	8.00	4.00	10.00
G-9 Cl. A concr. for crossover, mezzanine station and station tube sect.	7,200 cu. yd.	50.00	35.00	42.00
G-10 Cl. A concr. in open cut for aux. structures	1,540 cu. yd.	50.00	35.00	50.00
G-11 Cl. A concr. in tunnel for special structures	560 cu. yd.	25.00	50.00	31.50
G-12 Cl. B concr. for loading platform	580 cu. yd.	44.50	28.00	50.00
G-13 Cl. A concr. bulkheads in freight tunnel	100 cu. yd.	124.20	30.00	100.00
G-14 Fill concrete	350 cu. yd.	19.25	20.00	15.00
G-15 Concrete pavement	180 sq. yd.	4.00	10.00	3.25
G-16 Sidewalks, curbs and gutters	850 cu. ft.	1.00	1.50	1.00
G-17 Waterproofed sidewalks	300 cu. ft.	1.40	2.00	1.75
G-18 Timber for stairs, barricades and misc. work	7 M. ft. B.M.	200.00	200.00	250.00
G-19 Timber bulkheads	13 M. ft. B.M.	200.00	200.00	300.00
G-21 Reinforcement steel	5,200,000 lb.	.09	.07	.08
G-22 Furnishing and installing struct. steel	800,000 lb.	.15	.10	.15
G-23 Steel angles for anchorage	300 lin. ft.	1.25	4.00	2.00
G-24 Core borings	50 lin. ft.	6.00	10.00	7.50
G-25 Copper flashing	1,200 lb.	1.00	1.00	1.50
G-26 Membrane waterproofing	2,400 sq. yd.	5.40	3.00	4.00
G-27 Preformed waterproofing	600 sq. ft.	.35	1.00	1.00
G-28 Premoulded joint filler	300 sq. ft.	.50	1.00	1.00
G-29 Additional excavation in tunnel	200 cu. yd.	5.00	5.00	5.00
G-30 Rock excavation	50 cu. yd.	5.00	5.00	5.00
G-31 Additional cl. A concrete in tunnel	100 cu. yd.	12.00	12.00	12.00
G-32 Grout for stopping leaks	500 bbl.	10.00	10.00	10.00
G-33 Sub-piers for structure 5-D	1,200 cu. ft.	2.50	5.00	3.00
G-34 Single tube sect. 18'-0" internal width	1,100 lin. ft.	875.00	1,190.00	825.00
G-35 Single tube sect. 16'-6" internal width	640 lin. ft.	840.00	1,040.00	800.00
G-36 Single tube sect. 16'-0" internal width	635 lin. ft.	830.00	1,040.00	785.00
G-37 Junction at S. Wells St.	lump sum	531,000.00	350,000.00	615,000.00
G-38 Single tube sect. 15'-0" internal width	80 lin. ft.	826.00	790.00	775.00
M-1 Galvanized steel grating	1,300 sq. ft.	3.50	5.00	4.00
M-2 Miscellaneous steel	32,000 lb.	.35	.16	.30
M-3 Miscellaneous iron castings	31,000 lb.	.50	.25	.40
M-4 Bell and spigot c. i. pipe, 12 ft. and over	158,000 lb.	.10	.15	.11
M-5 Bell and spigot cast iron pipe over 3 ft. and less than 12 ft.	79,000 lb.	.15	.20	.15
M-6 Bell and spigot c. i. pipe, 3 ft. or less, and fittings	41,000 lb.	.20	.22	.28
M-7 3 and 4 in. threaded c. i. pipe	150 lin. ft.	1.00	3.00	1.50
M-8 3 and 4 in. fittings for threaded pipe	30 ftgs.	20.00	5.00	40.00
M-9 Pipe railing	50 lin. ft.	1.25	4.00	3.00
M-10 Steel spiral stairs	6,500 lb.	.75	.30	1.00
M-11 Steel doors, frames and louvers	lump sum	8,000.00	5,000.00	5,000.00
M-12 1-in. lead water service	20 lin. ft.	1.00	2.00	3.00
M-13 Pumping equipment	lump sum	10,000.00	20,000.00	7,500.00
E-1 Type A outlet boxes	750 boxes	5.25	10.00	7.00
E-2 Type B outlet boxes	250 boxes	5.85	10.00	5.00
E-3 Pull boxes, special boxes and covers	600 lb.	1.30	2.00	2.00
E-4 ¾ in. and smaller, rigid galv. electric conduit	3,500 lin. ft.	.41	.80	.40
E-5 1-in. rigid, galv. electric conduit	32,000 lin. ft.	.51	.99	.50
E-6 1¼-in. rigid, galv. electric conduit	1,200 lin. ft.	.65	1.20	.60
E-7 1½-in. rigid, galv. electric conduit	800 lin. ft.	.71	1.70	.80
E-8 2-in. rigid, galv. electric conduit	500 lin. ft.	.91	2.25	1.00
E-9 2½-in. rigid, galv. electric conduit	100 lin. ft.	1.23	3.00	1.25
E-10 3-in. rigid, galv. electric conduit	300 lin. ft.	1.61	3.50	1.50
E-11 3½-in. rigid galv. electric conduit	6,000 lin. ft.	1.95	4.70	2.00
E-12 4-in. rigid, galv. electric conduit	300 lin. ft.	2.45	5.00	2.50
E-13 3½-in. asbestos cement, stone or clay tile duct	16,000 lin. ft.	1.00	.80	1.50
E-14 Electrical work for power and lighting	lump sum	29,000.00	40,000.00	35,000.00
F-1 Excavation for reconst. of freight tunnel	2,600 cu. yd.	27.00	30.00	30.00
F-2 Cl. A concr. for reconst. of freight tunnel	1,100 cu. yd.	44.25	35.00	40.00
F-3 2-in. galv. steel pipe, incl. fittings	100 lin. ft.	.75	1.00	1.00
R-1 Shoring of La Salle St. R. R. Sta. track columns, types A, B and C	22 cols.	4,530.00	5,000.00	6,000.00
R-2 Shoring of La Salle St. R. R. Sta. track columns, Type D	66 cols.	3,125.00	3,500.00	4,500.00
R-3 Shoring of La Salle St. R. R. Sta. track columns, types E and F	25 cols.	3,650.00	4,000.00	6,000.00
R-4 Shoring of La Salle St. R. R. Sta. building columns, types G, H, and J	12 cols.	3,800.00	4,100.00	5,500.00
R-5 Sub-piers for La Salle St. R. R. Sta. columns	44,000 cu. ft.	2.75	3.00	2.80
R-6 Excavation for cap girders for La Salle St. R. R. Sta.	700 cu. yd.	17.20	20.00	30.00
R-7 Cl. A concr. for cap girders for La Salle St. R. R. Sta.	470 cu. yd.	14.25	25.00	25.00
R-8 Misc. steel for columns of La Salle St. R. R. Sta.	5,000 lb.	.12	.20	.20
R-9 Temporary facils. in La Salle St. R. R. Sta.	lump sum	4,200.00	8,000.00	15,000.00





These PRESSURE-CREOSOTED piles

lick a peace-time submarine menace

Extending for three miles, this tremendous pier on the Atlantic Coast carries miles of railroad track, and has facilities for loading a hundred ships at once. Since it was designed for permanent use, the engineers specified permanent materials, including pressure-creosoted piles and other structural members. Much of this material was treated by Koppers plants.

The importance of the protection of pressure-creosoting is shown by the almost incalculable damage done by marine borers to untreated piles. In a single west-coast harbor installation, damage has been estimated at $6,000,000 annually.

Experienced engineers depend on pressure-creosoted piles, as is indicated by their ever increasing use. In a recent 5-year period, 144,000,000 lineal feet were installed—enough to more than girdle the globe at the equator.

Pressure-creosoted foundation piles offer equally dependable protection against decay in installations where cut-offs are above the water table, and they also resist termite attack. Koppers plants are equipped to treat piles up to 130 feet long. Ask for quotations.

K

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PRESSURE-TREATED WOOD

KOPPERS COMPANY, INC., Pittsburgh 19, Pa.

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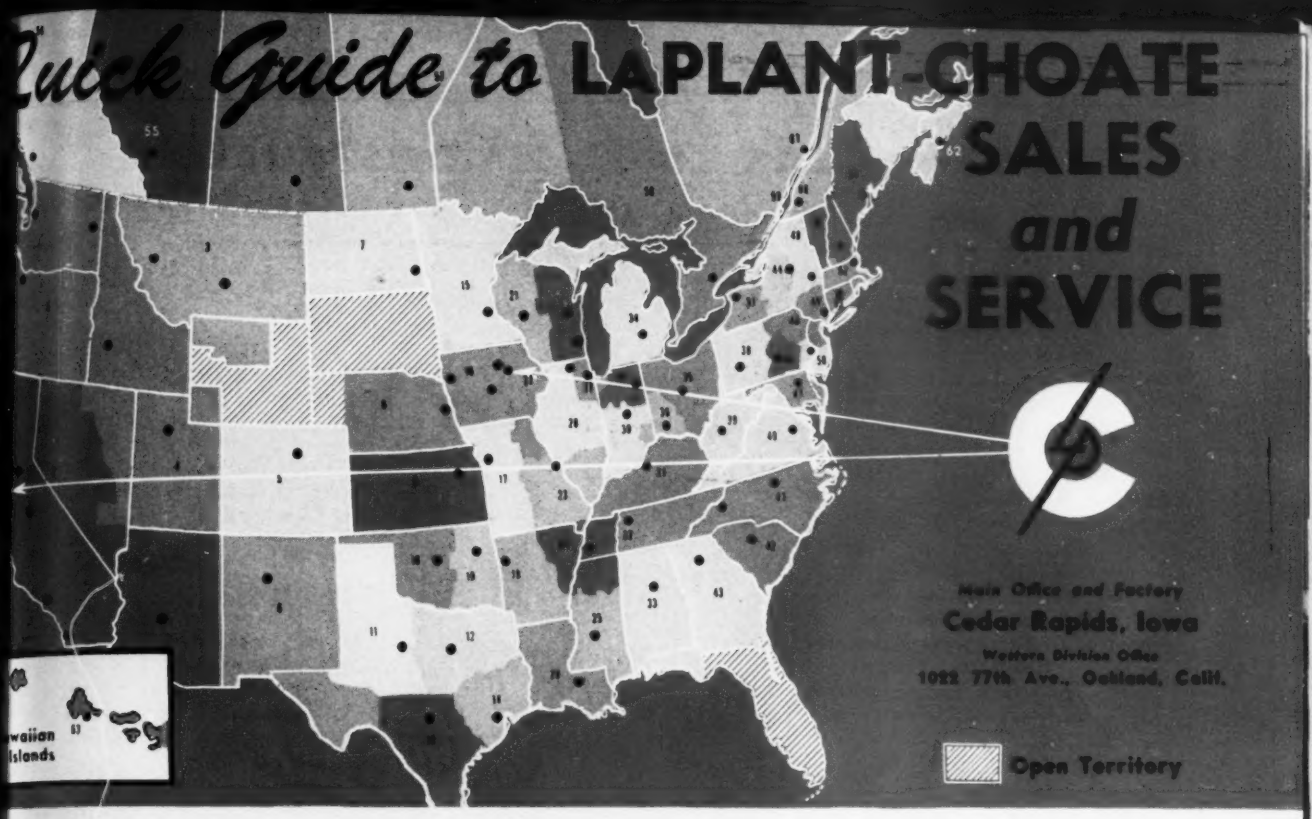

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44. Credle Equipment Co.
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45. Ensminger & Company
57 Wood Street
Wilkes-Barre, Pa.
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Mechanicsburg, Pennsylvania
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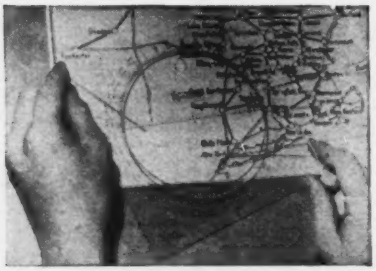
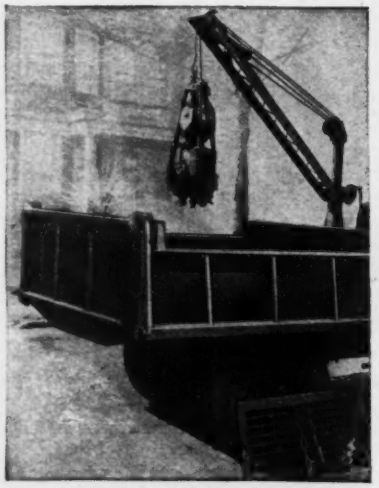
Safety-Locking Hose Coupling —LE-HI hose coupling, Series 150-B has a simple, positive, built-in locking device that provides maximum safety for workers using high-pressure air hose lines. This patented device eliminates danger of accidental uncoupling of hose lines under rough service conditions, yet permits instant and easy engagement or disengagement of couplings. No tools are required to operate the coupling and no nails, cotter-pins, etc., are needed. These couplings are fully interchangeable with other Universal-type couplings made to accepted standards. Constructed entirely of bronze, they possess rugged strength and resistance to rust or corrosion.—*Hose Accessories Co., 2702-F N. 17th St., Philadelphia 32, Pa.*

Gas-Driven Power Chain Saw —Built of latest type magnesium alloy, chain saw features cutting blade that swivels to eight different positions for easy cutting, built-in oiler on helpers' end for effective chain lubrication, gas tank cast integral with engine housing, and heavy-duty, long-life chain. Power source is a dependable 6-hp. two-cycle Homelite engine with built-in governor and rotary valve assuring consistent performance, long life and low upkeep. Production at present is on 24-in. and 36-in. sizes weighing 90 and 95 lb. respectively—*Lombard Governor Corp., Ashland, Mass.*



Plotting Instrument —Known as "Plotractor", this new instrument is able to compute its own angles from bearings, eliminating need to figure independently interior and exterior angles. Interior rotor revolves full 360 deg. and is calibrated the same as surveyor's transit. Instrument is made of Nitron, cellulosic product of *Monsanto Chemical Co.'s Plastics Division.—Cardinell Products, Montclair, N. J.*



Catch Basin Cleaner—Installed on 160-in. wheelbase truck chassis, the cleaner takes so little room behind cab that it can be used in conjunction with full-size dump body, thus enabling one truck to do a complete job of cleaning out the manholes and disposing of the mud. Unit consists of a jib-boom crane, winch and Hayward 18-in. orange peel bucket. Crane will lift up to 1,500 lb. at any radius and is adjustable to radii of from 4 ft. 3 in. to 9 ft., and has swing angle of 350 deg.

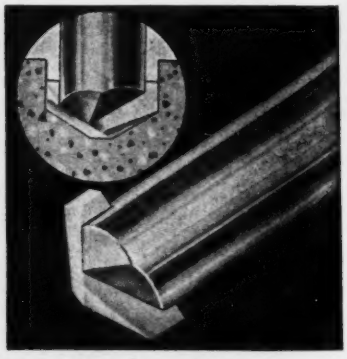
Double drum winch with a line pull of 1,500 lb. is controlled by single lever. Swinger mechanism is rapid reverse gear unit developed for military cranes, controlled by single foot treadle. Boom is adjusted to desired height and radius by worm-geared, hand-powered winch. Power is furnished by engine through heavy-duty, single-speed power take-off. —*Gar Wood Industries, Inc., Detroit 11, Mich.*

All-Position Electrode — The new improved #107 electrode is the result of extensive research in extruded coatings for work involving poor fit-up on mild steel. It is recommended for single or multiple pass welding on rusty or dirty plates or sections. This low-cost electrode embraces excellent arc characteristics, working equally as well on DC straight or reversed polarity as on AC.

Other advantages are that the electrode can be used with abnormally high welding current; has high deposition rates; permits use of "dragging technique"; has more forceful arc action, and offers high burn-off rate.—*Wilson Welder & Metals Co., Inc., 60 East 42nd St., New York 17, N. Y.*

Magnesium Ladder—A lightweight ladder of all-welded magnesium construction weighs only 5½ lb. in an 8-ft. length, while the weight of the 24-ft. extension ladder has been cut to 31 lb. Permanent strength, safety and rigidity are said to be additional features of these ladders.

All-metal construction avoids splintering and deterioration due to weather exposure. Welding of the rungs into the side channels assures complete freedom from the loosened joints which make a ladder wobbly and unsafe.—*White Aircraft Corp., Palmer, Mass.*



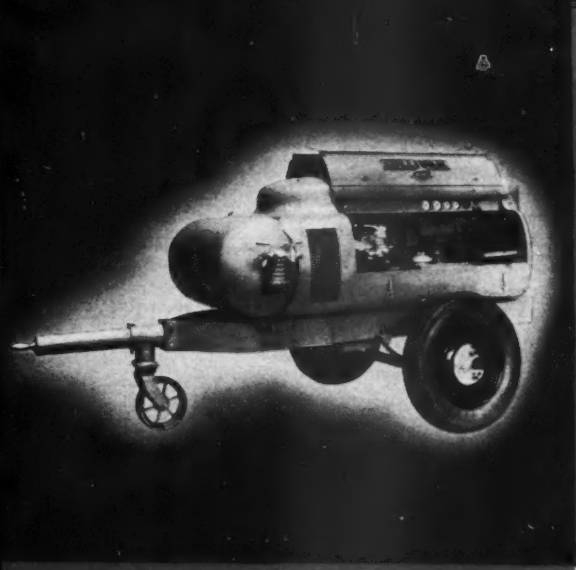
Rotary Masonry Drills—A line of Kennadrills for rotary drilling in concrete, brick, slate, marble, limestone, plaster, glazed tile, asbestos, and other non-metallic construction materials, have cutting tips of Kennametal. The drill is so designed that the tip extends beyond the diameter of the shank, thereby providing generous annular clearance space around the shank for cuttings, minimizing the possibility of binding. No starting punch is required on very hard or brittle materials, and glazed surfaces are not chipped or cracked because the tip takes hold readily.

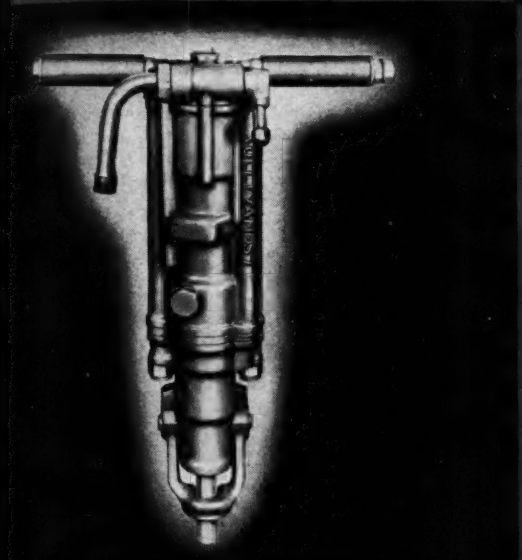
Any rotary type of drill can be used to operate Kennadrills, available in nine sizes.—*Kennametal Inc., Latrobe, Pa.*

SULLIVAN WK-80 IR COMPRESSORS

...rovide peak air power

The improved design of these compact, portable, two-stage units, and the "Econo-Miser" Load Control, assures plentiful air power at less cost. Gasoline models in sizes 60 to 315 CFM; Diesel, 85 to 630 CFM.





SULLIVAN SILVER STREAK CADMIUM PLATED ROCK DRILLS

have patented "DualValve" that makes air do more work

You'll get greater drilling speeds . . . longer life and better lubrication from your drills if they're Sullivan products. Cadmium plating permits more accurate running in—closer tolerance on cylinder and piston.

SULLIVAN SILVER STREAK CADMIUM PLATED AVING BREAKERS

are rugged, powerful hard-hitting hammers

Dual-Valve equipped . . . using less air . . . these rugged breakers are easier to handle because their flat-sided cylinder provides a more comfortable working surface against the user's leg.

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New, modern state constitution favors industry. Low taxes. Unlimited water supply and abundant natural resources. Unexcelled transportation facilities. Furthermore, Missouri offers the skilled, friendly labor you need—with 350 alert communities eager to do business with you.

2,251 new corporations in first nine months of 1946

Specialized, confidential service to industrialists. Write direct: Missouri State Division of Resources and Development, Dept. M57, Jefferson City, Mo.

THE STATE OF MISSOURI
In The Heart of America

Manufacturers' Activities

PLANS FOR CONSTRUCTION of a fabricating and assembly plant for the new double-glazed insulating Twindow unit are announced by Harry B. Higgins, Pittsburgh Plate Glass Co. president. It will be located at Creighton, Pa. and construction will begin as soon as approval is granted by CPA.

FAYETTE LEISTER, veteran of a quarter-century of service as an anti-friction bearing engineer, has been elected by directors of The Fafnir Bearing Co., New Britain, Conn., as vice-president in charge of engineering.

Appointment of HARRISON WOOD as New York district manager for SKF Industries, Inc., ball and roller bearing manufacturers, is announced by R. R. Zisette, general sales manager. Mr. Wood, assistant district manager since 1941 and for many years a field engineer for the firm, succeeds John D. Williamson, who resigned because of ill health.

T. J. FLYNN has resumed his duties at the southeastern sales office of the American Lumber and Treating Co., 721 Graham Bldg., Jacksonville, Fla., after 48 months of military service.

Supervisory changes in the MINNEAPOLIS-HONEYWELL REGULATOR CO. have been announced by C. B. Sweatt, executive vice president. James S. Locke is sales manager of the division in Minneapolis. George D. Guler is regional manager in Atlanta. He succeeds Albert H. Koch who is now Philadelphia branch manager. Succeeding Mr. Locke in Chicago will be J. F. Cummiskey, while L. C. Johnson has been promoted to branch manager in Milwaukee, replacing Harold Pride. J. C. Dorsey is in charge of manufacturers' business in Philadelphia. In Minneapolis, T. S. Carley is sales manager of the wholesale division and of Honeywell's stoker controls division.

The new million dollar plant of the TIDEWATER PLYWOOD CO. at Brunswick, Ga., is expected to begin operations soon, according to Col. John T. Houk, president. Georgia hardwood will be converted into water-resistant plywood. Colonel Houk said that due to shortage of certain equipment, plywood production is not likely to begin until late in November.

Manufacturers' Publications

Electric Power — Describes generating plants, independent generators, high-frequency generators, rotary converters and battery chargers.—*Kato Engineering Co., Mankato, Minn.*

Wire Rope — (4-p. folder) Describes and illustrates four principal lays of wire rope.—*Union Wire Rope Corp., 21st & Manchester Sts., Kansas City 3, Mo.*

Pneumatic Transmissions — (16-p. bulletin) Written by D. P. Eckman and Louis Gess, it covers advantages and means of pneumatic transmission of instrument reading over long distances.—*Brown Instrument Co., Division of Minneapolis-Honeywell Regulator Co., Philadelphia, Pa.*

Stone Finish — (24-p., illustrated brochure) Describes patented Formstone process for new construction and renovation of exteriors and interiors, which can be applied over shingles, weatherboard, brick, stucco, cinder block or concrete blocks.—*Formstone Co., 200 S. Franklintown Rd., Baltimore, Md.*

Machinery Bearings — (6-p. folder) Describes oilless bearings and illustrates variety of uses. Installation features are listed.—*Nolu Oilless Bearing Co., 18 E. Johnson St., Germantown 44, Philadelphia, Pa.*

Welding Electrodes (64-p. catalog) Includes complete descriptions, color identifications, specifications conformed to, physical properties, welding procedures, recommended ranges and sizes available in the entire line of Hollup electrodes—mild steel, alloy steel, stainless, hard facing, cast iron, etc. There are tables on the weldability of metals, appearance inspection of welds, electrode consumption estimating chart and definitions of welding terms.—*Hollup Corp., 4700 W. 19th St., Chicago 50, Ill.*

Water-Softening Methods—Explains basic types of ion-exchanging water softeners for industrial, institutional and municipal use. Water softeners are of both pressure and gravity types which feature automatic equipment to control backwashing, brining and rinsing processes.—*The Permutit Co., 330 W. 42 St., New York 18, N. Y.*

Next thing to Gibraltar!

You just can't give steel and concrete the resistance to weather and corrosion that Mother Nature built into The Rock.

But you can come close.

When you're considering protection for steelwork on docks and wharves . . . or any other structure . . . be sure to specify Flintkote Asphalt Emulsions.

This bituminous material is the modern, economical way to seal out moisture, and dull the knife-edged attacks of time, wind and weather. Spray it or brush it on to form a tough, durable skin that won't flow under heat or crack and alligator under continued exposure.

Flintkote manufactures a wide variety of products for use in the Marine field. These include Deckings, Adhesives, Bituminous Enamels, Protective Coatings for metals and insulation materials and many other purposes aboard ships and on shore.

These are only a few of the many ways that Flintkote can help you come closer to building a Gibraltar. Ask for the details.

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★ As MANEUVERABLE as a motor patrol
★ Road SPEEDS 2 to 14 miles per hour
★ ONE MAN operated
★ Handles up to 4 cu. ft. windrows
★ Mixing speeds from 11.5 to 71 feet per minute
★ 100 to 150 tons of mix per hour
★ Ideal for SMALL JOBS with BIG JOB capacity

The Model 36 incorporates all of the proved features of the famous Wood Roadmixers, Models 48 and 54, plus maneuverability, speed and self-propulsion. Ask your local Wood Roadmixer Dealer or write direct to the Wood Manufacturing Company for your copy of Bulletin 36. It gives complete details and specifications on this sensational, self-propelled traveling mixing plant. 2-36

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EXTRAS—MODEL 3000
Detachable compass $13.75
Stadia wires 5.00
Extra leg tripod 15.00

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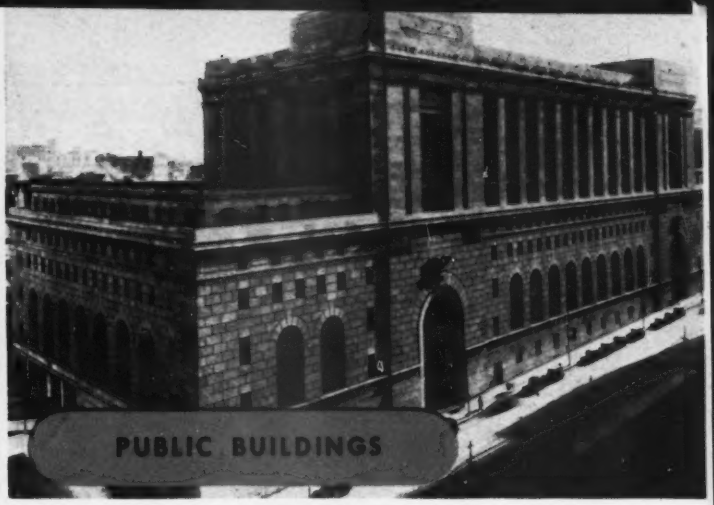
Elections and Activities

Newly elected officers of the Illinois Municipal League are: President, Mayor Egbert A. Smith, Cairo; first vice-president, Mayor S. G. Ingraham, Evanston. Harry B. Luers, commissioner, Springfield, is treasurer; William H. Winterhoff, supervisor, Thornton Township, is seargent-at-arms. Also chosen were the following new vice-presidents: Dwight H. Wulf, Bellwood; D. R. Lapan, Galva; Arthur O. Janke, Joliet; G. W. Smith, Mattoon; Earl K. Broberg, Maywood; Harry C. Bishop, Mt. Vernon; and Ronald E. Shawger, Sterling.

James H. Park, Compton, Calif., has been re-elected president of the Pacific Coast Building Officials' Conference. Other officers re-elected were first vice-president, Harold O. Rasmussen, Santa Ana, Calif.; second vice-president, Frank H. Rogers, Medford, Ore. Appointed managing-secretary was Hal Colling, Pasadena, Calif. Co-operation of building officials in Canada and the United States is urged by the conference for writing of an international building code to bring uniformity of building materials to protect the public from unscrupulous dealers.

G. F. Fountain, assistant city engineer, Vancouver, B.C. has been elected chairman of the British Columbia Public Works and Municipal Engineers' Association. A. S. G. Musgrave, Oak Bay municipal engineer, was elected secretary-treasurer. Committee members elected were: Evan Jones, district engineer, public works department, New Westminster; Neil McCallum, provincial surfacing engineer, provincial works department, Vancouver; Don McGugan, civil engineer, New Westminster, and E. Q. Richardson, Municipal engineer, West Vancouver.

At the golden anniversary meeting of the Pennsylvania Water Works Association, held Oct. 16 at Atlantic City, N. J., John H. Murdoch, Jr., was re-elected president. Mr. Murdoch has held the post since 1928. Other officers elected were: Nathan B. Jacobs of Pittsburgh, first vice-president; W. F. O. Rosenmiller of York, second vice-president; Alan K. Taylor, Brownsville, third vice-president. E. R. Hannum of Windber was elected secretary-treasurer.



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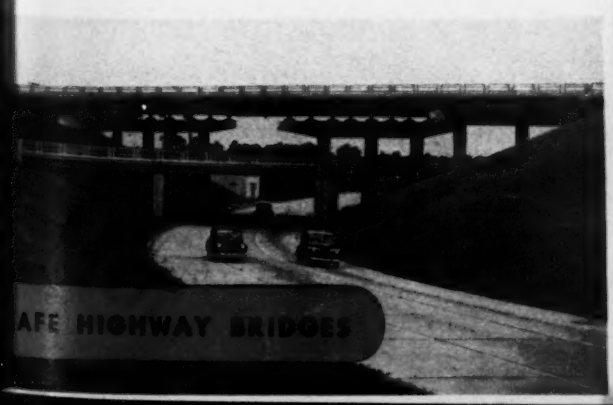

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MEN AND JOBS

Robert C. Smith, lately an officer in the United States Navy, has been appointed West Coast labor relations official for the Bureau of Reclamation and has established offices in the Sacramento headquarters of the bureau. With 25 years of experience in construction work as a civil engineer in Newfoundland, eastern United States, Mexico and Canada, he holds the Silver Star, the Bronze Star and the Navy Unit Citation for his direction of pre-invasion underwater demolition for three European invasions and the Philippine operation. As a neutral government observer, Smith will function as mediator and arbitrator between labor and contractors on all western reclamation projects.

M. G. Johnson has resigned as assistant to the chairman of the Indianapolis Postwar Planning Committee, effective Nov. 1. Mr. Johnson served the committee as an engineer on a full-time basis almost from its inception in 1944. The committee recently issued its final report, the result of two years' study and research during which a 7-year program of municipal modernization and improvement was formed. Mr. Johnson will enter private engineering practice.

The appointment of **I. W. Peters** as highway engineer of Knox County, Tenn., has been announced. He succeeds **Biscoe Acuff.**

Thomas R. Luckett, an engineer in the office of the city engineer at Kansas City, Kan., has resigned to become assistant to the chief engineer in the real estate department of the War Assets Administration in Kansas City, Mo.

J. Broder Frans, county engineer of Buchanan County, has been named city engineer at St. Joseph, Mo.

Maj. Lazarus H. Todd, recently associate member of the joint logistics plans committee of the Office of the Chief of Engineers, has returned to inactive status. Mr. Todd is now chief of the logistics section of the plans and training division in that office. Following graduation from the University of Alabama in 1934, Mr. Todd spent three years on flood control work in the New Orleans District of the Army Engineers. In 1940 he was ordered to active duty at Ft. Benning as a company commander with the 20th Engineer Regiment and was next assigned in connection with military construction in Mobile, Ala., district of the Army Engineers, later serving in the Wilmington, N. C., district on a similar assignment. In November, 1943, he transferred to the plans and training division, Office of the Chief of Engineers. Part of the time spent with the plans division was in the office of the theater engineer of the China theater for the purpose of establishing engineer planning procedure there.

A. John Horn has rejoined Gannett, Fleming, Corddry & Carpenter, Harrisburg, Pa., as sanitary engineer concerned with design of sewage treatment and draining projects in Pennsylvania. He served 3 years as captain in the Sanitary Corps and saw service in the Amazon Valley of Brazil, in New Caledonia, Guadalcanal, Northern Solomons, Bismarck Archipelago, Philippine Islands and Japan as commanding officer of a malaria control unit, and also as assistant in the setting up of the Manila Health Department.

Dr. Hermann Baumann, inspector general of the Bureau of Roads of Peru, is now in this country for a second visit under the auspices of the Institute of Inter-American Affairs, the American Road Builders' Association and the Public Roads Administration. Dr. Baumann is studying American highway construction and design methods, and is attempting to buy construction machinery. He is a civil engineering graduate of one of the leading universities of Peru.

Nomer Gray is resident engineer for Ammann and Whitney on the construction of a $2,500,000 reinforced concrete hangar, shop and office building for American Airlines at the Chicago Municipal Airport. He was formerly chief of the structural design section of the Bureau of Bridge Design, Department of Public Works of the City of New York.

W. A. Woodward, civil engineer who was with a construction battalion in the Pacific, has become town manager of Ashland, Va., to supervise the town's new sewer, water and street improvements.